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Say you saw it in The OIL WEEKLY

Seminole Decline Leaves Only West Texas to Worry

Rapid completion of drilling wells in flush Oklahoma area, with few new tests starting, promises continuation of rapid decline

By KENT RIDLEY

CONTINUATION of the erratic fluctuations of production in the Seminole area, which has brought the output there to figures where the umpire is considering the advisability of permitting the shooting of some of the smaller producers, is turning interest in future over-supply in market damaging quantities to West Texas. Some reports from that area are to the effect that 1000 additional wells are to be drilled there within the next six months, but these reports do not come from sources directly interested in the oil situation. Economists already are criticising action of West Texas operators in running their oil to storage, with threats that the probable price brought about by such action will barely equal the cost of the tanks, with no margin to cover the cost of the oil.

It is significant and a helpful fact as regards continuation of the decline in production, which is the only element of strength in the present market, that new wells being started are far below the number of completions, particularly in Oklahoma and Kansas, a circumstance which will hasten the decline at Seminole when the majority of those wells drilling will be completed within four or five weeks.

Production Drop

American Petroleum Institute compilations of estimates give the daily average production for the week ending October 22 at 2,481,750 barrels, a decline of 12,600 barrels from the average of the previous week. This decrease is a continuation of the decline, which has continued with minor fluctuations since the first of August, and is the lowest point reached since May. The latter period of decline, it will be noted from the accompanying chart, covers the period of greatest increase during last year.

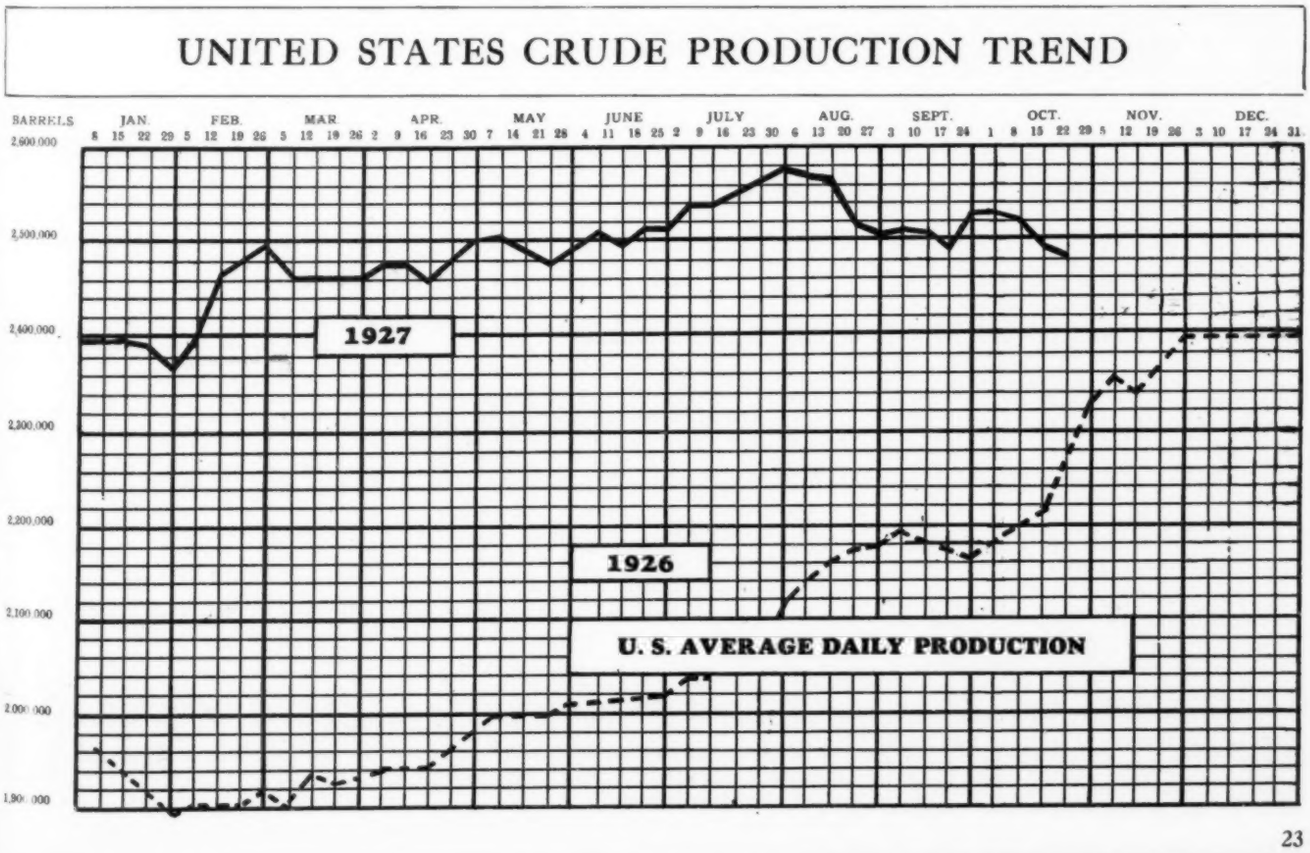
Oklahoma again accounted for the chief drop in production, the average of 779,200 barrels representing a decline of 11,000 barrels. In the Seminole area Little River field showed an increase from 39,550 to 44,400 barrels, while Bowlegs, Seminole, Searight and Earlsboro each declined, the combined daily average being 14,850 barrels lower than for the previous week. The daily average for the entire Seminole area, therefore, was 10,000 barrels lower than for the previous week. Current reports indicate that a much greater drop will be recorded in the next weekly report.

The daily average for Texas was 617,900 barrels, an increase of 900 barrels. West Texas increased 5000 barrels and the Texas Gulf Coast section 3000 barrels, but these gains were offset by decreases in all other sections of the State.

California's daily yield for the week was 624,900 barrels, a decrease of 4300 barrels; that of Kansas was 104,950 barrels, a decrease of 200; of Arkansas 100,900 barrels, decrease 150; of Louisiana 66,450, decrease 350 barrels. The Rocky Mountain States as a whole experienced an increase of 600 barrels in the daily yield, while the Eastern States showed a gain of 1500 barrels, the figure being 114,500 barrels.

Completions

During the past week 403 tests were completed in the entire United States, with no report from California, while



DETAILS ON CRITICAL FIELDS

Pool—	Oil Wells Completed	Total Initial Production	Initial Per Well	No. Producing Wells	Daily Production Barrels	Daily Production Per Well	Rigs Up	Wells Drilling
CALIFORNIA—								
Seal Beach	224	294,152	1,313	119	60,900	512	29	45
OKLAHOMA—								
Seminole	998	1,371,578	1,099	933	419,510	438	26	295

during the previous week, including 24 for California, there were 428 completions. Included among the completions the past week there were 255 producers, and during the preceding week there were 272. But the combined initial production of the 255 wells was greater than that of the 272, the figures being 99,516 barrels, and 95,264 barrels respectively.

This increase in the yield per well was due largely to results in West Texas, where several unusually large producers were reported. Pecos County in that section reported there wells of more than 10,000 barrels. The California Company's Yates 3, the initial of which was 14,400 barrels; Marland & McMann's Yates 2, initial 13,080 barrels, and Roxana Petroleum Company's Smith A-1, initial 10,030 barrels.

The total number of new wells in Texas was 40, their combined initial amounting to 58,120 barrels. During the previous week 54 new wells yielded 42,417 barrels.

Oklahoma's new wells, on the other hand, were not as large on the average as during the previous week. The combined initial of the 56 new producers was 35,747 barrels, while during the previous week 39 wells yielded 34,178 barrels. The total number of completions in Oklahoma was 94 as against 75 for the previous week.

In all the other sections the figures on completions and initial production from new wells tallied closely with the figures for the previous week.

New Wells

During the week ending October 22 there were 236 permits for new tests issued in the principal oil producing sections, exclusive of California and the Rocky Mountain States. During the previous week there were only 208 permits.

Texas accounted for the large increase in permits, the figure being 154 as against 93 for the preceding week. Oklahoma issued 55, an increase of seven; Kansas, 13, an increase of five; Arkansas, five, increase two; and Louisiana nine, a decrease of seven.

Decline in Greater Seminole crude production has brought over the Mid-Continent territory a better general feeling concerning markets. This decline is believed to be the first step of a big, general decline in the Seminole pools' enormous production.

Field activity over Oklahoma and Kansas continues to slump, and this slump is especially noticeable in the Seminole area. There has been a decline of 99 in the number of drilling wells in the five Seminole pools within the past four weeks, and it is evident now that after the next three or four weeks of intensive drilling, due to the greater majority of drilling wells being near completion depths, the new production added to the fields will not be able to hold the production to anywhere near the present level.

If the daily yield at Seminole continues to fall during the remaining weeks of the year at a rate undergone during the past week, operators will not have to fear a price cut, and furthermore a more rapid period of reconstruction is likely in 1928 than has been expected over the territory generally. While Seminole operators cannot hope to compete with crude producers in the shallow West Texas fields, due to the difference in recovery of the oil, Seminole oil has the quality of producing a great demand in the face of a flood of oil considered inferior by refiners. While Seminole crude was going about breaking the crude market in the spring it was also selling itself to the refiner on the fact that it was the most desirable crude on the market. And so, there is a strong chance of Seminole and other Oklahoma crude finding a differential from West Texas oils generally in the event of a flood of crude there after Seminole production attains a low enough point for the calling for a drawing on stocks.

California Stocks Decline

The latest report of the Pacific Coast office of the American Petroleum Institute shows that total California stocks declined almost 1,000,000 barrels during September. A small decline was expected, but the reduction was much larger than generally anticipated. Refinable crude, 20 degrees A. P. I. and lighter, led all other stocks in the decline, with a net loss of more than 900,000 barrels. Light crude stocks are now more than 7,000,000 barrels less than at the same time last year, totaling 23,000,000 barrels, as against considerably more than 30,000,000 barrels on October 1, 1926. Gasoline stocks remained almost at a standstill but naphtha distillates were reduced 431,000 barrels. Heavy crude stocks increased 188,000 barrels, while miscellaneous stocks increased 334,000 barrels. Total California stocks are now nearly 4,000,000 barrels under the total storage one year ago.

The hottest weather of the year in California has raised local gasoline consumption to a figure close to the summer's average, but such a rate can hardly be expected to continue for a long period. Filling stations report their week-end business as unusually high, due to the rush for beaches and mountain resorts.

With the practical assurance that the Ventura field will be partially shut in and a steady decrease expected in the Seal Beach field, California operators have turned their attention to the possibilities in the Potrero district and in the deep sands at Long Beach, both of which have much promise. The completion of a commercial well on the Sulphur Mountain structure also adds to the complexity of the situation. The Round Mountain field is facing a development program which will undoubtedly raise the State's production several thousand barrels.

The demand for fuel oil in California is good, with exports showing strength. Inquiries from along the Atlantic seaboard indicate that cities along the eastern fringe of the country will again be in the market for large quantities of California fuel oil.

Balance Sheet of Oil Outlook

By James H. Gardner, of Tulsa
President of the Gardner Petroleum Company

ASSETS

1. Steady increase of consumption for established demands.
2. Relatively quiet outlook in Kansas, Arkansas, Louisiana, East Texas, Gulf Coast and Rocky Mountains.
3. Seminole district on down grade and decline of semi-flush production elsewhere.
4. Precedent established in co-operative shut downs.
5. West Texas production in limestone and granite wash with some viscous grades and sulphur content.
6. Increase in U. S. in 1927 more than combined output of Mexico and Venezuela.
7. Greatly reduced number of drilling wells.
8. Winter months ahead to further slow up production and drilling wells.
9. Few new pools in Oklahoma outside Seminole and great depth of Lovell (5960').
10. Increased development of motor busses, closed cars, aeroplanes, domestic heaters and farm machinery for new demands.
11. Favorable outlook in general business.
12. Lack of market and pipe line facilities on western border of Mid-Continent.
13. Pessimism.

LIABILITIES

1. Storage much too big.
2. Large amount acreage proven for development in West Texas.
3. Menace of Yates pool, on up-grade.
4. Rapid flush from air-gas lift.
5. Increase of gasoline storage in winter months.
6. Reasonable stability in enlarged settled production.
7. Prospects of new pools on resumption of intensified drilling in California and Mid-Continent.
8. Increase of refinery installations for greater gasoline recovery.
9. Construction plans for more efficient motors in gasoline efficiency.
10. Plans for increased pipe line facilities on western border of Mid-Continent.
11. Rising production in South America.
12. Shut in production of Wyoming and California.
13. Optimism.

Encourage Engineers as Means of Conservation

A. P. I. "Committee of Seven" looks to engineering skill as best means of conserving oil; may form special division

By WALLACE DAVIS
Staff Representative

PONCA CITY, Okla.—A step which is considered by some of the leading executives over the nation to be the greatest ever made in the history of the oil industry was taken at the three-day meeting last week of the American Petroleum Institute's "Committee of Seven" on the conservation of natural gas and the economic production of oil held simultaneously with the sub-committee of scientists and petroleum engineers at the Marland Oil Company headquarters at Ponca City.

Nothing definitely developed from the "Committee of Seven's" conference except for a decision to meet at the Stephens Hotel in Chicago, December 2, for the purpose of discussing the reports, which at the close of the Ponca City meeting October 19 had not been compiled, made by the sub-committee, and the arrival at some final conclusion at the Chicago meeting on these reports for a report to the American Petroleum Institute. The legal committee, composed of James A. Veasey, Carter Oil Company; D. A. Richardson, Marland Oil Company, and Rush Greenslade, Gypsy Oil Company, which conferred jointly with the "Committee of Seven" October 19, decided also to meet at Chicago with the latter committee.

Conclusions arrived at during the Ponca City meeting mean summarily that the oil industry hereafter is going in strong for the educational side of the work, that every conceivable measure will be taken toward developing co-operative work on the part of the operating companies and with engineers and scientists capable of aiding in the progress of the industry. The results of discussions on the floor between practical petroleum engineers and scientists heading such work in the leading colleges and universities over the country during the three-day conference of the sub-committee is considered invaluable in the opinion of E. W. Clark, president of the American Petroleum Institute, and the members of the president's committee, E. W. Marland, chairman; Sid. H. Keughan, Henry McGraw, W. S. Farish, J. Edgar Pew and L. P. St. Clair, who were present at the meeting. Thomas A. O'Donnell, the seventh member of the committee, was not present at the meeting, not being in this country at the time.

Place of the Engineer

The general idea growing out of this conference, which, if followed up by the American Petroleum Institute, can clear up the present problems confronting the industry concerning economic production, and handle in good shape further problems that arise from time to time, it is believed by leading operators commenting on the conference. "The engineer, if allowed to work co-operatively, is destined to be the leader in the future, and today the college professor is coming to the front in an advisory capacity over field results, and is being placed in various lines of research work the oil industry has thus far lacked in the main part, statements of executives of the leading companies represented at the meeting said:

In this connection President Clark of the A. P. I. said: "The petroleum engineer is in the industry to stay; he has sold himself to the industry as invaluable, and he is being accepted thus by oil men who at the start rejected him as co-worker."

Further statements of executives along this line were made in the form of suggestions that the college professors doing scientific work which would be of aid to the oil industry should be used in research work in the field, which no doubt would result within the coming few years in a clearing up of the present problems by truth that could not be disputed.

Engineers' Organization

Such important light was brought to the operators in attendance at the Ponca City conference by the petroleum engineers that a definite decision was made for making the organization of engineers in the industry a permanent thing. The discussion along lines of bringing about a new organization had not been decided on at the close of the conference, but the outcome was expected to be that of centralizing more effort on these engineering organizations growing out of the conservation work. Regardless of the outcome of this particular plan the research work of the engineer is voted unanimously to be carried on with greater interest and backing by the producing ends of the business.

The meeting of the technical committee, which consisted of petroleum engineers, and scientists, together with visiting engineers enough to run the total attendance to more than 100, was carried out without an interruption. E. W. Marland presided over the first day of the conference, while Earle Oliver, consulting engineer, who was elected during the meeting as the national chairman over the technical sub-committees from California, the Rocky Mountains, the Mid-Continent and the Gulf Coast, headed the meetings thereafter. Petroleum engineers and professors in turn were named to take the witness chair to briefly state their own impressions of the question of conservation of gas and the economic production of oil, and then to answer questions asked from the floor. In effect, the conference was somewhat of a round-table discussion.

While practically every question dealing with recovery, especially in the economic phase, was brought up, many of outstanding interest, consumed the major portion of the three-day sitting. Such problems as replacing the original gas with other natural gas or with artificial gas or like constituents, the rapid and accurate method of analyzing hydro-carbons, the effect of different drives on the sand, including the question of the possible use of sea water as a drive for its reputed theoretical benefit in cutting the oil film, the effect of various artificial properties or even the constituents of natural gas separately on the viscosity on petroleum, the advisability of taking the maximum or minimum gas from the well, the possible hazard and at the same time the possible benefit of back pressure placed on wells, and the feasibility of putting into effect co-operative development of fields in the face of present problems.

For the purpose of getting a general opinion as to a plan for gas conservation and economical oil production each engineer and scientific worker brought to the stand was asked the following questions at the opening day of the conference:

Gas Conservation

"Assuming the high importance attached by this meeting to the principle of gas conservation to produce oil, does it follow that experience in the particular pool or in relation to a particular property or well will develop the method to be applied to conserve gas to its fullest efficiency to produce oil?

Assuming that you answer the foregoing question in the affirmative, does it follow that if the lessee on adjacent lands or even a lessee holding lands anywhere in the pool does not observe the practices proven to be proper, that such acts on their part will actually deprive the operators willing to follow the practice of part of the oil which they might ultimately obtain?

While our knowledge upon the subject

at the moment may not be sufficiently comprehensible to demonstrate the particular gas conservation method or methods which should be employed, is it not true that there are certain practices of the industry at present in relation to gas which have the effect of depriving adjacent lessee or lessees anywhere in the pool of the opportunity ultimately to recover as much oil as they would if these practices were not being followed?

Is it possible to drill a well in a pool without changing the character of wells or the amount of production on neighboring leases or in the pool at large?

Each man taking the stand was asked for an opinion on some plan that might be followed in conservation and economic production. Generally, the first three questions were answered in the affirmative, while the fourth received the negative in nearly every case.

The general opinion voiced concerning the legal problem being faced by work of putting over co-operative field work is that this presents apparently no great difficulty. As a comparative example the case of "no law against building in residential sections of a city was considered feasible not many years ago," was cited, and the measure of trying to put over such enforcements at that time was considered out of the question. If the point is reached where a certain high percentage of operators agree to unite co-operatively in developing an oil pool, the remainder of the operators will be forced into such a beneficial pact, it was brought out; and furthermore, if certain restrictions against waste are enforced, the unwilling operator will be reduced to co-operate in the desired plan of operation or be left out of the running altogether.

The near future was cited as the time when practically all of the worthwhile development will be in the hand of the major company, at which time the proposed co-operative development will be easily carried out, it was explained on the last day of the conference. The time is already here when the operator who cannot afford a 2000-pound pressure valve on a well can not afford well to go into the operating business on a big scale, according to many views, and the time is not far away when the man who cannot afford to invest $150,000 in a well cannot well afford to stay in the operating business, as the future of drilling is already seen to lie in deep production, much deeper than that of today.

Seventeenth Producer at Nash Dome; 450 Barrels

Houston.—Rycade Oil Corporation has completed its Wisdom 17 at Nash Dome as a producer. It came in for an initial flow of 450 barrels of pipe line oil from 3931 feet.

This is the seventeenth producer that has been brought in at Nash Dome since its discovery by means of the torsion balance in 1924, the 17 producers representing the reward for the drilling of 42 holes. With the completion of this new well there now are 14 producing in the fields.

Five Big Wells Are Completed in Yates Field; Production Above Curtailment Quota

SAN ANGELO, Texas.—Activity in the Yates pool, Pecos County, held above normal this week and showed a gain both in drilling and in production. Total production, according to pipe line runs, amounted to 30,470 barrels, 470 barrels above the proration percentage announced by the purchasing companies last week.

Five big wells were completed, all of them inside wells, however.

Initial production of these completions was estimated on the basis of hourly flows and the biggest producer was the California Company's Yates 3, which flowed at the rate of 14,400 barrels daily from 1205 feet. Marland and McMan Oil Company's Yates 2 was the second best well, making 13,080 barrels from 1291 feet. Yates 5, on the same lease, was good for 3900 barrels from 1695 feet, and No. 6 showed 5180 barrels from 1632 feet. The fifth well was the Humble's Smith 1, good for 2088 barrels from 1600 feet.

All these producers were pinched in after the initial test was made.

Considerable interest was attached to the Mazda Oil Corporation and the Savoy Oil Company's Smith 1, which was making 200 barrels daily early in the week, from 1578 feet. The well is a southwest extension to the Yates pool and although it is a small producer, it is considered a good marker. That the producing formation thins out toward the southwest, seems likely. However, the Mazda test is said to be responsible for acreage changing hands at fancy prices. The well topped the salt at 800 feet, with an elevation of 2705 feet. On October 16 there were heads of oil amounting to about 17 barrels every two hours, but two days later the hole swabbed dry. Then on October 22 production was estimated at 200 barrels daily.

Transcontinental Oil Company's Blackstone and Slaughter 1, section 149, block 20, T. & St. L. Railway survey, reported to have had a show of oil last week was drilling lime this week at 1825 feet. This test is a rank wildcat southwest of the pool.

The startling statement that 1000 completions can be looked for in the Yates field during the next 10 months appeared in North Texas newspapers early in the week. Such a drilling program is altogether possible, but highly improbable as things now stand. Few operators in North and West Texas believe the producing area is large enough to justify that many wells, and if it turns out to be large enough there could be found little justification for such wholesale drilling. The entire West Texas district is a menace, which unless carefully handled is capable of throwing the industry into a worse condition than Seminole has thrown it.

Undoubtedly the water situation in the Yates field is to be reckoned with sooner or later too. Last week the Mid-Kansas and Transcontinental's Yates 3-B showed water in large quantities, although thought to be immune from this trouble. Formerly, this well, higher structurally than its neighbors, had not made any water. It is now believed that the Yates pool has a hydrostatic head beneath it similar to Mexican pools, a fact which has considerable significance.

Mid-Kansas and Transcontinental are showing more activity than any other operators in the field. These companies have seven wells drilling, one straightening a crooked hole, five riging up and five locations.

The Gulf Production Company started operations in the field last week on its Mrs. M. A. Smith and I. G. Yates leases. Three outfits are drilling on the Yates property, and one rig is running on the Smith lease.

A check at the beginning of the week showed a total of 70 operations in the field, including drilling wells, rigs either in process of being built or already completed, locations, wells shut down, wells fishing, wells cemented, and materials on the ground for derrick construction. Results were as follows: Drilling wells, 21; rigs, 17; locations, 13; wells shut down for various reasons, 12; wells fishing, 1; wells waiting on cement to set, 2, and materials on location, 4.

Ranger Has Celebration on Tenth Anniversary

Ranger, Texas.—Ranger was host to all West Texas last week when it held the Golden Jubilee celebrating the tenth anniversary of the discovery of oil in the Ranger field. Visitors to the jubilee came from all North and West Texas to join in the celebration.

A parade several miles long was the official opening of the jubilee. In the parade were representative floats from neighboring cities and towns.

Significance of the jubilee was emphasized by W. B. Hamilton of Wichita Falls, chairman of the oil and gas bureau of the West Texas Chamber of Commerce. Mr. Hamilton was one of the speakers who opened the formal program. Among the other speakers was United States Senator Earle B. Mayfield.

A bronze tablet was unveiled on the site of the discovery well, Texas Pacific Coal and Oil Company's McCleskey 1, by Miss Frances Gholson.

Officials of many of the leading oil companies were present at the jubilee and a number of them were guests at a special dinner.

Potrero Well Makes Less Than 225 Barrels Initial

Capabilities of pool opener are not known, as much water is coming with oil and gas flow; dry holes have been drilled on three sides

By BRAD MILLS
Staff Representative

LOS ANGELES.—The completion last week of a commercial oil well in the Potrero district, near Los Angeles, has been the principal Cailfornia topic, having temporarily drawn the spotlight from all less critical areas.

The Associated Oil Company clung tenaciously to the theory that an oil pool existed on its holdings at Potrero, despite failure after failure north, east and southwest of the Cypress well, which gets the honor of opening the pool. The company spent several hundred thousand dollars in blocking up what it considered the most promising leases and it now comes to light that it apparently has the cream of the new area.

Theory is still rampant as to the possible trend of production. A careful study of dry holes drilled on three sides indicates that the field can extend only to the northwest, but only further drilling will disclose the actual trend of production.

The discovery well was not as large as first reports indicated. The actual initial production was less than 225 barrels, with a flow of 2,500,000 feet of gas. Total depth was 4717 feet. Although the well is a commercial producer, its capabilities are questionable. Considerable water is accompanying the oil and the Associated Oil Company is facing the problem of either trying to locate the source of the trouble or drilling deeper. In either case, Cypress 1 has served its purpose and to it will go the honor of opening up a new pool. There is a good chance that the well will be deepened to test the sands which should correspond with those found in certain parts of the Rosecrans field.

The history of the Potrero field reads like fiction. A superficial boom was precipitated early in the year, following frenzied speculation by lease brokers. Leases commanded almost unheard-of prices for strictly wildcat acreage, many of the larger companies taking protection acreage. Royalties of less than one per cent were sold at fancy prices. A dozen derricks sprang up, but few wells were drilled. Sensational developments were lacking, and the derricks quietly came down. The value of the leases dropped at once.

The Associated came desperately near to making a producer of Cypress 1 several months ago at 4450 feet, but was finally forced to go deeper. The company was ridiculed a great deal for its persistency, but is now reaping the benefits of its efforts.

Seal Beach

The Seal Beach field made a miserable showing during the week with only two small recompletions in the entire area. No new completions were recorded. The result was a drop in production of more than 5000 barrels. All possible wells are on the line, indicating that the slump was a natural one.

A well-known Los Angeles geologist recently made a public statement that a large number of wells in the Alamitos Heights area would cease to be profitable producers in less than a year. The faulty condition of the field places it on a different plane than the Long Beach and Santa Fe Springs field, where an almost unbroken sand more than 2000 feet thick exists.

More than two dozen wells are now headed for the Wasem sand, but they are not expected to materially raise the field's production. An upset is possible, but far from probable.

With many of the major operators inclined toward secrecy, the progress of several deep tests in the Long Beach field has not been available. The extent of the deepening campaign to follow is a matter of uncertainty. Following the completion of several large wells around 5500 feet, it is known that many other wells will be sent down to test the same formation in other parts of the field.

The remarkable tenacity of the California Petroleum Corporation's Davidson 6, which was a 2100-barrel completion a week ago, was the feature of the week. The well is still producing within 100 barrels of its initial output, with the gravity unchanged and the cut still negligible. The company was so pleased with the action of the well that it will drill four more wells on the Davidson, Robinson and Griswold leases.

The Richfield Oil Company, as the result of the recent acquisition of the Delaney holdings, is expected to deepen several wells, in addition to its regular development program. The company hopes to double the production from the Delaney leases, which were producing around 4000 barrels when purchased two months ago.

Huntington Beach

Aside from the excitement caused by efforts to extend the field in several directions, the Huntington Beach area was comparatively quiet during the past week. Production showed a slight decrease in both the beach and townsite sectors, but the slump should not be taken seriously. There is unmistakably a slight downward trend, but the settled condition of the wells insures a production well above 60,000 barrels for many months. New wells completed from time to time will undoubtedly keep the output up to a figure which approximates the present producing sand continue to register around 125 barrels, while those in the upper or tar zone have an initial equally as high. The differential between the initial production of the upper and lower sand wells has practically been wiped out.

The Standard Oil Company's Pacific Electric 14 has been completed with an initial production of 125 barrels, showing exactly the same yield as Pacific Electric 13 and 15, which were completed a week ago. No. 14 was a much shallower well, having been completed at only 3540 feet. Production from the well is cutting about 35 per cent, but is expected to clean up within the next week. The Ahlburg Gasoline Corporation completed the only shallow sand well during the week—Lee 9, which was originally drilled to 2745 feet and plugged back to 2092 feet. The well produced 75 barrels of 12 gravity oil on the initial test. The crude showed a cut of 20 per cent.

The excitement created by the discovery of an oil sand in the Calnan Petroleum Corporation's wildcat, nearly a mile northeast of the Huntington Beach field, has subsided somewhat,

(Continued on page 68

3500 Barrels From Deep Sand at Long Beach

Long Beach, Calif.—L. T. Edwards, independent operator in the Long Beach field, has completed his Brayton 1 as a 3500-barrel well, making it the largest producer yet finished in the deep sand. Total depth was 5637 feet. The casing pressure is 800 pounds and the tubing pressure 150 pounds, with the remarkable well producing through two small beans.

The oil is about 30 gravity and absolutely clean. Immediately following the completion of the Edwards well, Doyle & Clune scored with a 3400-barrel producer at 5717 feet.

A survey of the field showed a total of 30 wells headed for the deeper sand.

Gas Men Have Varied Program for Discussion at Southwest Division Meeting at Houston

Houston—Various features of unusual interest have been included in the program that has been arranged for the autumn meeting of the Southwest Division, Natural Gas Department, of the American Gas Association at Houston on the three days beginning October 31. The States which will be represented at the meeting are Kansas, Oklahoma, Texas, Arkansas and Louisiana.

One of the special features of the program will be the showing of a film by the Houston Pipe Line Company on Tuesday evening, November 1, showing by motion pictures the industrial development of the territory contiguous to Houston and the Gulf Coast region.

N. C. McGowen, chairman of the Natural Gas Department, American Gas Association, will preside at the meeting. On the morning of the first day of the meeting, Monday, October 31, two papers will be read and discussed following the readings. These papers will be "Standardizing the Open Flow From Natural Gas Wells," by T. W. Johnson, R. R. Brandenthaler and E. L. Rawlins, U. S. Bureau of Mines, Bartlesville, Oklahoma; and "The Value of Property Appearance and Maintenence," by R. J. Daugherty, the Empire Companies, Bartlesville, Oklahoma.

The afternoon session of the first day will be devoted to the reading and discussion of three papers, as follows: "Natural Gas Problems of the Southwest," Frank Kirk, Houston Pipe Line Company; "Development of Conservation of Natural Gas," William F. Chisholm, director of Minerals Division, Louisiana Conservation Commission, and "Institutional Advertising," Keith Clevenger, the Empire Companies, Bartlesville, Oklahoma.

On the morning of the second day of the meeting Major Alexander Forward, managing director of the American Gas Association, will make an address on "The Place of Gas in the American Gas Association." His address will be followed by the reading and subsequent discussion of two papers: "House Heating With Gas," J. W. Duvall, Oklahoma Gas and Electric Company, Oklahoma City, and "Fundamentals in Arriving at Gas Reserve in the Southwest Territory," J. S. Ivy, of the Palmer Corporation, Shreveport, Louisiana.

During the afternoon session Tuesday, November 1, the following questions will be discussed: What are the advantages and disadvantages of curb box meters? What are the advantages and disadvantages of the several methods of protecting gas service lines? What results have been obtained in protecting steel pipe lines from soil corrosion? What is being done to further the sale of gas engine gas? What would be the advantages of making industrial installations on an installment payment plan? What is the best way to control high pressure gas wells? Can an upper gas sand be mudded off and later reclaimed as a producing gas sand?

The third day will be devoted partly to discussion of problems confronting the gas producer and partly to plans for the annual national meeting of the Natural Gas Department of the American Gas Association.

Among the subjects that have been scheduled for discussion on the third day are the following: The advantages of straightening valves in orifice meter settings; comparison of low pressure and intermediate systems of domestic distribution; gas as an industrial fuel compared with oil and lignite; whether or not the distributing company shall sell gas appliances; and industrial gas salesmanship.

A smoker with appropriate entertainment features has been arranged for the evening of Monday, October 31, and on the following evening after the showing of the film of the Houston Pipe Line Company, there will be a dance in honor of the visitors.

A special committee of Houston women have arranged a series of entertainments for the visiting women during the period of the convention.

The committee on arrangements which has prepared the program consists of the following men: C. B. McKinley, chairman; W. A. Raymond, J. F. Cushing, C. Lee Wood, H. E. Denner, A. E. McKiearnan, M. A. Hardie, C. V. Allin, Marvey S. Smith, Charlie Kirk, Halsey Tucker and J. A. Dormant.

Gas Conservation Cuts Ventura Output

Los Angeles—The much-discussed Ventura curtailment was put in effect October 25, resulting in a reduction of approximately 4000 barrels daily. Under the new plan, it was agreed among the principal producing companies of the field to reduce the volume of gas 25,000,000 cubic feet daily. The situation was an unusual one, in that the point involved was the wasting of gas rather than the overproduction of oil. Governor Young frowned upon the actual waste of upward of 100,000,000 cubic feet of gas daily, claiming that the loss was too great from an economic standpoint to be tolerated for the sake of a few thousand barrels of oil. The reduction of oil production was necessary to bring about the conservation of gas.

5000 Barrel Flow Follows Deepening of Gulf's Well South and East of Pampa

Amarillo, Texas.—Further interest in the new Bowers pool, south and east of Pampa, centered on the Gulf's Bowers 1-A, which was drilled deeper this week and made better than 5000 barrels in 21 hours. The well was completed nearly a month ago at 3003 feet, but made only a small flow at that time. Interest in Delaney et al's Jackson 1 prompted the deepening of the Bowers test and the enormous flow followed when the well was drilled from 3003 to 3015 feet.

No water showed with the oil and the gravity test was 43.4

The well is in section 89, block B-2, a little more than a half mile north from the Delaney well. Danciger Oil Company's Jackson 1, an offset to the Bowers 1-A, has a good oil show and would probably make a 150-barrel producer, but its owners have decided to drill deeper, and are now making hole below 3080 feet. The same company has four other tests drilling on the Jackson lease: No. 2, drilling at 1600 feet; No. 3, drilling at 1325 feet, and No. 4, drilling at 252 feet.

Delaney et al's Jackson 2, an offset to the discovery well, is fishing at 200 feet.

Following on the heels of the Gulf's well came the information that the Phillips Petroleum Company has purchased a one-half operating interest in 880 acres around the Delaney well for a reported consideration of $1,000,000. The purchase was made from a group of Wichita Falls men.

Practically all the acreage between the Bowers well and the Pampa field, which is nearly two miles north, will come in for testing, probably to the deep horizon from which the Bowers is producing.

Outside this deep pay area, activity in the Panhandle is slack. This week production dropped to 88,675 barrels, a daily average of 11,500 barrels. Four new wells were completed.

In Carson County, The Texas Company got a 30-barrel producer from its M. P. Fee 4, at 3162 feet. Phillips and Gibson's Whittenburg 13, Hutchinson County, was good for 300 barrels from 2713 feet, and in the same county The Texas Company's Lewis 3 pumped 15 barrels from 3084 feet.

Empire Gas and Fuel Company abandoned its Johnson Brothers 7 "B," Hutchinson County, at 2016 feet, but the Great Plains Oil Company's Lee Bivins 1 made 80,000,000 feet of gas from 3135 feet. The Piney Oil Company also got an 81,000,000 feet gasser in Wheeler County, at 1978 feet.

Marland et al's Flores 1, Sherman County, was abandoned as a failure at 4003 feet.

Frank Champion, superintendent of the Central Texas Division of the Prairie Oil and Gas Company, driller for the Texas Pacific Coal and Oil Company, when McCleskey 1, the Ranger discovery well, was drilled in, attended the Golden Jubilee at Ranger last week.

Drilling Indicates Continued Drop In Seminole Output

Average of 15 locations per week will not provide new oil to offset decline at present rate; most of wells due soon

By WALLACE DAVIS
Staff Representative

TULSA—The daily average production of the Greater Seminole area dropped from 443,097 barrels on October 17, to 419,510 barrels on October 24, a daily decline of 3369 barrels. This level represents a new figure for the field during the past six weeks, and came within 285 barrels of reaching the low mark of September 14.

Following are the production figures by field in the Seminole area for October 24, as compared with October 17:

Field—	Wells	Oct. 24	Wells	Oct. 17
Earlsboro	243	160,225	229	171,173
Bowlegs	257	121,190	257	129,925
Seminole	330	65,593	324	69,047
Searight	60	26,477	60	27,328
Little River	45	46,130	40	45,624
Totals	933	419,510	910	443,097

Monday's figure shows a decline of 108,040 barrels, as compared with the area's peak of 527,250 barrels made on July 30.

A weak comeback in yield temporarily stopped the phenomenal decline Saturday of last week at which time the daily production increased 419,693 barrels on Friday to 422,140 barrels. Sunday the level showed practically no fluctuation, and Monday's output was down 2930 barrels. While better air pressure and the addition of several small wells served to slow up the rapid downward trend of the enormous output at the close of the week, indications were early this week that the decline would continue in spite of any action taken in the five pools.

On October 24 there were 338 operations in the Seminole area, including 259 wells drilling, 26 rigs up, 17 locations staked, and 32 operations shut down. This is a decline during the past week of 29 operations, and incidentally a decline of the same number of drilling wells.

Little River

Little River had 93 operations Monday, including three locations, 12 rigs up, six wells shut down and 78 wells drilling. Forty-eight of the drilling wells were below 3700 feet, 14 were drilling above 2000 feet, six drilling between 2000 and 3100 feet and 10 between 3100 and 3700 feet. This, the newest of the five producing spots of the market breaking area, is, considering the age of the pool as compared with its forerunners of Seminole County, offering prospects of being the weakest pool. Production there, which was predicted to run more than 100,000 barrels within a few weeks after the wells in the heart of the productive spot started coming in, is having a struggle to hold its own after 45 wells have been completed on every side of the discovery well, that set a false pace too high for the development wells to reach. Air or gas has been applied to almost half of the completed wells, and the producers are failing to respond to artificial subsidy as these methods did in the other four pools. Deepening of the holes is a hazardous practice at Little River, so close is the pay sand to the water level. What wells have been deepened have failed in most cases to profit greatly by it, and some of them have been damaged rather than improved.

The following examples will show the effect on production of Little River wells when deepened: Indian Territory Illuminating Oil Company's Dugan 3, in section 35, was deepened four feet to 4121 feet last week with no increase, making 564 barrels in 20 hours. Its Jackson 2, in section seven, was deepened one foot to 4180 feet, with no increase, swabbing 640 barrels in 24 hours. Carter Oil Company's Fish 1, in section 36, failed to increase, swabbing 980 barrels in 16 hours after deepening three feet to 4135 feet. Amerada's Nitey 1, in section 2-7-6, was making 130 barrels of oil and 50 barrels of water October 23. Philmack and White Eagle Oil & Refining Company's Davis 1, located in the northeast of the southwest of the southeast of section 1-7-6, south of the center of the producing area at Little River, made 685 barrels in 21 hours on October 20, showing for a little better production than that of the initial about two weeks ago. I. T. I. O. Company's House 1 discovery well in the northwest corner of section 1-7-6, had dropped to 645 barrels of oil and was making 220 barrels of water on October 19. The same company's Soketheche well, in the northwest of the northeast of 1-7-6, east side of Little River, made no increase when deepened two feet to 4318, and swabbed 441 barrels of oil in 20 hours. Blackwell Oil & Gas Company's Nitey 6, in the southwest of the northeast of the southeast of section 35-8-6, decreased 365 barrels on air October 18, making 1930 barrels that day.

Earlsboro

The outstanding well reported at Earlsboro during the week is Continental's Kays 2, which topped the pay at 4276 feet, drilled to 4294 feet and flowed 1855 barrels in 17 hours. It is located in the southwest of section 2-9-5. Earlsboro, which still leads by far in activity in the Seminole area, had 118 operations Monday, including four locations, four rigs up, 11 wells shut down, four wells drilling above 2000 feet, seven between 2000 and 3100 feet, 21 between 3100 and 3700 feet and 78 wells drilling below 3700 feet. This activity represents a drop of 14 operations in the field during the past week.

Bowlegs had eight locations staked Monday, 10 rigs up, 12 wells shut down, two wells drilling above 2000 feet, four between 2000 and 3100 feet, eight between 3100 and 3700 feet and 59 drilling below 3700 feet. This figure on operations shows a decline of four during the week at Bowlegs.

Seminole City pool had one location staked Monday, no rigs up, three wells shut down, one well drilling above 2000 feet, one between 2000 and 3100 feet, two between 3100 and 3700 feet and 11 wells below 3700 feet.

At Searight there were two locations, no rigs or wells shut down, one well above 2000 feet, three between 2000 and 3700 feet, five between 3100 and 3700 feet and 10 wells below 3700 feet.

It is interesting to note that out of the 295 wells drilling 206 of them are due for completion within the next three or four weeks. Since new wells in the Seminole area are now averaging only around 500 barrels, considering the number of failures, the initial production is seen to be unable to hold the total daily production with the present rate of decline among old producers. With only an average of about 15 new locations a week, there would only be 60 new operations started within the coming month at the most to

Seminole Reaches New Low Production Level

Tulsa — The Greater Seminole area reached a new low production level with the gauge reported for the period ending Tuesday morning, with 416,472 barrels, as follows:

Earlsboro	159,430
Bowlegs	121,289
Little River	43,850
Seminole City	65,180
Searight	26,723

Reports are current that Umpire Collins plans allowing the shooting of approximately 100 wells in the area within a short period, provided production is not increased over 15,000 barrels, and no shooting to be permitted except in small producers.

offset more than 200 completions, either producers or dry. It is this situation mainly that leads operators to now visualize Seminole as out of the danger spot as far as future markets are concerned, at least as compared with its former bearing on markets.

Pontotoc County

Outside of the Seminole area there is little activity of any great significance. The northwest extension of the Allen pool of Pontotoc County, in section 17-5-8, is finding the most centralized play outside of Seminole and its surrounding vicinity. Louisiana Oil Refining Corporation's McElroy 2, in the southwest of the southwest of the southeast of section 17-5n8e, flowed 700 barrels pinched in October 21 with sand at 2447-74 feet. When opened 20 hours it made 52 barrels an hour for two hours, and made 1000 barrels in 20 hours, cutting 10 per cent water. W. R. Ramsey's Webb 2, in the northwest of the northeast of the southwest of section 20-5-8, made 400 barrels from 2395-97 feet and found a deeper sand at 2442-52 feet. Ramsey's Parker 1, in the southwest of the northwest of the southeast of section 17-5-8 flowed 750 barrels from 2377-2413 feet late in the week.

Early this week there were 12 or 15 rigs being moved into the northwest Allen field extension in township five north-range eight east, Pontotoc County. The extension, which lies almost in a northern loop of the Canadian River, has 15 producers, 22 wells drilling, one gas well and four dry holes. The extension area has undergone fairly concentrated play within the past five months.

In the Wildhorse area of northern Lincoln County, Wilcox sand production has shown up exceedingly well in the Shaffer Oil Refining Company's Connell 1 and T. P. Coal & Oil Company's Bett 1, both located in section 31-17-5. The Shaffer well had an initial yield of 73 barrels an hour from 4210-40 feet at its location in the southeast corner of the southwest quarter of section 31. Texas Pacific Coal & Oil Company's Bett 1, one-quarter of a mile east, made around 1000 barrels initial and since has increased to as high as 1800 barrels. Its production level is slightly lower than that in the Shaffer well.

Field activity in Oklahoma and Kansas continue on the decline with new operations failing to hold up in number. There are 192 wells shut down in Oklahoma and 64 shut down in Kansas fields, according to compilations of October 12. During that week activity, however, showed less slump than during the average week of the past two months. There was a decrease of only eight operations in Oklahoma and one in Kansas.

The accompanying table outlines the field activity in Oklahoma and Kansas for October 12 as compared with activity for one week previous:

JUDGE J. C. DENTON

Denton Named President of Division

Tulsa—Judge J. C. Denton, vice president and chief counsel of the Mid-Continent Petroleum Corporation, and an outstanding legal figure in the oil industry in the Mid-Continent territory, has succeeded Henry McGraw, vice president of the Gypsy Oil Company, as president of the Kansas-Oklahoma division of the Mid-Continent Oil & Gas Association, having been elected to that position at a meeting Friday, October 21, of the newly elected executive committee.

Judge Denton was formerly in the government service, and came to the Mid-Continent Petroleum Corporation from Muskogee some time ago.

Mr. McGraw, retiring president of the Kansas-Oklahoma division of the association, declined the offer to continue longer as president. C. C. Herndon, vice president of the Skelly Oil Company, was elected first vice president of the association, succeeding Lee Scott of the White Eagle Oil & Refining Company of Kansas City. A. M. Landon of Independence, Kansas, was re-elected vice president for Kansas, Wirt Franklin of Ardmore, vice president for Southern Oklahoma, and Hohn H. Kane of Bartlesville, vice president for Northern Oklahoma. Harry H. Smith, secretary-treasurer and general counsel, was re-elected to that position.

Mr. and Mrs. John J. Durst are to spend the next six months at their home in San Antonio, Texas, during a leave of absence granted Mr. Durst by Oil Well Supply Company, of which he is Rocky Mountain district manager. Mr. Durst has been company manager both in Louisiana and Texas and in both states as well as throughout the Rocky Mountain district the Dursts have hosts of friends.

	October 5						October 12					
	Lcn.	Rigs	Dr.	S. D.	Com.	Total	Lcn	Rigs.	Dr.	S. D.	Com	Total
Oklahoma—Ponca City District:												
Tonkawa	1	..	2	3	..	6	1	..	3	2	..	6
Outside	8	3	25	22	3	61	5	3	21	27	..	56
Osage District:												
Burbank	1	3	7	9	2	22	..	2	10	8	1	21
Outside	8	6	14	6	1	35	2	8	14	4	2	30
Other Districts:												
Enid	6	6	31	21	3	67	5	4	28	26	1	65
Cushing	4	3	29	9	2	47	3	2	31	8	4	48
Tulsa-Okmulgee	7	44	46	23	18	138	8	44	54	19	11	136
Shawnee-Seminole	25	21	386	36	44	512	22	28	412	42	28	532
Muskogee	..	6	26	19	12	63	..	6	31	18	6	61
Lawton Dist.	7	4	48	23	10	92	8	..	47	25	15	95
Ardmore	..	7	64	16	2	89	..	7	63	13	7	90
Total	67	103	678	187	97	1,132	55	104	714	192	75	1,140
Kansas	25	39	117	64	7	252	22	41	113	64	13	253

Big Production Area Extension in Hendricks Pool

Ida Hendricks 1 makes flow of 500 barrels per hour on test; development on increase in Winkler County

By A. R. McTEE
Staff Representative

SAN ANGELO, Texas.—Drilling in of what appears to be perhaps the biggest producer yet completed in the Hendricks pool, Winkler County, caused interest in the West Texas district to shift temporarily from the Yates field. Cranfill-Reynolds et al's Ida Hendricks 1 gauged 500 barrels per hour on a test flow early in the week, from 2883 feet. The well is located 990 feet from the north and 330 feet from the west lines of section 28, block B-5, and proves considerable acreage for big production. To the north approximately three-quarters of a mile is the Gulf's Smith lease, and the nearest production on the south is that on the Southern Crude Purchasing Company's Mrs. Ida Hendricks lease, nearly two miles away.

Of course it cannot be said definitely that all the territory between the new well and the nearest production on both sides will be productive, but indications are good that this will be the case. The strip toward the north is practically certain to show big pay, and a good many operators are convinced that other good wells will follow toward the south.

The general trend of development in Winkler County is toward an increase. The past week showed gains amounting to six drilling wells, one location, four rigs and derricks, and 535 barrels in output.

The Cranfill-Reynolds well was not reported as a completion, but was pinched in instead, following the test.

Total output of the field was 11,160 barrels from wells on six leases.

The number of tests shut down on top of the big lime decreased from 22 to 10 inasmuch as several companies are resuming drilling on wells that have been shut down pending the outcome of other tests, general conditions of the crude market, etc.

This decision to deepen wells on top of the lime is not widespread, however, at this time, but if a few companies decide on such a policy, others will undoubtedly fall into line.

Tank Building

Individual operators are going ahead with plans to take care of their production. Roxana Petroleum Corporation, which recently acquired an interest in holdings belonging to Landreth, has announced the addition of another 80,000 barrel tank to be built in section 40, the north one-half of the southwest quarter, block B-5. Roxana previously planned to build one 80 on this site, but the recent increase in Winkler County activity, with drilling in of the Cranfill-Reynolds well close to Roxana acreage, probably led to the decision to double storage capacity. This week Roxana also had an engineer from California in the field looking over possibilities for the construction of a 3,000,000 barrel concrete storage tank, probably on a site in the southwest quarter of section 30, block B-5. No announcement has been made by the company to this effect, but such plans have been in contemplation for some time.

Roxana's individual holdings and interests held with other concerns in West Texas, put the company in position to support a trunk line system to handle its production out of West Texas, and it is very probable that an announcement of such a pipe line will be forthcoming before long. The Ozark Pipe Line Company' Roxana's transportation subsidiary, has a ten-inch line extending from the Healdton, Oklahoma, field, to Roxana's refineries at Arkansas City, Kansas; Wood River, Illinois, and East Chicago, Indiana. These plants have a maximum skimming capacity totaling 76,000 barrels, and Roxana's West Texas properties are being counted on to supply much of the crude that is to keep these plants operating.

An extension of the Healdton line across the plains of West Texas to Winkler would afford a shorter transportation route than could be had by moving the oil to tidewater.

In addition to extensive holdings in Winkler County, Roxana has settled production in the McCamey field amounting to 2500 barrels daily.

This week, Murchison-Mayston announce the immediate construction of a six-inch line from the Winkler pool to the Texas and Pacific railroad, where a loading rack will be built. Site of the rack has not yet been determined.

Pure Oil Company also is to build a loading rack at Wickett, instead of Pyote, as was previously announced. Pure is planning to build a line from the field to Wickett, where two 55,000 barrel tanks are being built. Grading for one of these tanks has been completed in the center of the southeast quarter of section 34, block B-5.

Church and Weekly are to build two 55,000-barrel tanks in section 29, block B-5, to take care of their Winkler County production, and Independent Oil and Gas Company is getting ready to put two 55's on the south end of its 80-acre lease, section 29, block B-5.

These tanks are in addition to the ones previously announced and indicate extent of preparation being made to take care of production on the leases.

Although the Winkler field is not yet defined in at least two directions, com-

The status of field operations in the Hendricks field, Winkler County, Texas, at the close of last week is shown below:

Operators—	Locations	Rigs and Dks.	Drill Tests	Shut Down on Lime	Completed Wells	Initial Prod.	Present Prod.
Amerada Pet. Corp.	..	..	1	..	..	....	...
Arizona Mining & Eng. Company	..	1	..	..	..	....	...
Atlantic Oil Prod. Co.	..	2	5	..	..	....	...
Geo. M. Church-Fields et al	1	..	1	..	..	....	...
Cranfill Bros. Oil Co.	..	..	1	..	..	....	...
Cranfill-Reynolds, et al	..	1	2	..	..	....	930
Gulf Prod. Co.	..	1	1	4	..	....	30
Humble Oil & Ref. Co.	..	2	3	1	..	....	905
Ind. Oil & Gas Company	1	1	3	..	..	....	880
Landreth Prod. & Roxana	..	4	3	..	..	....	7,910
Liner Drilling Co., et al	..	1	..	..	..	....	...
Marland Oil Co.	1	1	1	1	..	....	325
Joe Maxwell & Turman	..	1	1	..	..	....	...
Murchison-Cranfill & Marland	2	..	1	..	..	....	...
Murchison-Cranfill	..	..	1	..	..	....	...
Pure Oil Co.	1	..	2	..	..	....	880
Republic Prod. Co.	..	1	3	..	..	....	...
Roxana Pet. Corp.	..	1	4	..	..	....	...
Sheldon & Burden	..	1	..	..	..	....	...
Southern Crude Oil Pur. Co.	..	..	5	4	..	....	7,910
Texon Oil & Land Co.	..	2	2	..	..	....	...
Total	6	20	40	10	1	1,160	11,160
Totals previous week	5	16	34	22	1	1,135	10,625

*Production partially pinched.

pletion of Humble's Hendricks 1, section 36, gives an idea of what can be expected toward the northwest. This well was located in the center of the southeast quarter of section 36, block 27. It picked up the top of the salt at 2120 feet, showed the lime at 3095 feet, and was abandoned as a dry hole at 3258 feet. The test was approximately two miles northwest from the nearest production.

Llano Oil Company and Roxana's Scarborough 1, located in the center of section 1, block C-22, P. S. Lands, swabbed 70 barrels and preparations were being made this week to put the well on the pump. Elevation on this test is 2943 feet, and the top of the salt was logged at 1115 feet.

Drilling Continues Active In Dale Field

Houston.—The Texas Company is going ahead rapidly in a renewed effort to find oil in paying quantities in the serpentine field at Dale, Caldwell County. Early this week the Texas-Humble Clingingsmith 4 was drilling at 65 feet; the Clingingsmith 5 on the same lease was drilling at 938 feet in shale; and the Clingingsmith 6 was at 915 feet in shale. A derrick was up for the No. 7 on the Texas-Humble lease and Lackey 4 of The Texas Company was rigging up. The No. 5 and No. 6 tests on the Texas-Humble lease will likely be down to the pay level some time next week. Producers which have been completed in the field have varied in depth from 1980 to about 2250 feet.

Three of the wells that have been drilled by The Texas Company at Dale are producing at present, and two others are potential producers preparing to pump.

The Texas Company's Beaty 1-A, discovery well of the field, brought in August 5, flowing 250 barrels by heads, is producing consistently. Early this week it was making 59 barrels daily. It has been producing at practically the same rate since it was put on the pump a short time after completion.

The Beaty 2-A of The Texas Company is also a consistent well. It produced 135 barrels last Monday. This well came in about September 15 for 600 barrels but soon dropped off and has been pumping subsequently at about the present rate.

The third of the three wells now producing for The Texas Company is the No. 3 on the Texas-Humble Clingingsmith lease. It is making about 27 barrels. It was completed about the middle of September as a 45-barrel pumper. The two wells which are preparing to pump are The Texas Company's Lackey 1, and the Clingingsmith 2, owned jointly by The Texas Company and Humble Oil & Refining Company. This was the sensational well of the field, producing 360 barrels during one hour when first brought in. It fell off rapidly, however, and within a week after completion was making 219 barrels a day by heads.

Economist Gives Views on Production Situation at Engineers' Smoker at Fort Worth

FORT WORTH.—Joseph E. Pogue, petroleum economist of New York, in viewing the possible outcome of present activity in West Texas, can see nothing but a recurrence or a continuation in 1928 of the past year's flood of oil, according to an address made by him before the members and guests of the Petroleum Division of the American Institute of Mining and Metallurgical Engineers at a smoker here last Wednesday night.

"Standing in the shadow of the West Texas production cloud," as he expressed it, Mr. Pogue said that he could not help but feel very pessimistic over the prospect for the coming year. Present indications lead him to believe that an extensive drilling program will be launched in this area during the early months of 1928 with a resultant period of high production averages during the summer months that will probably be of sufficient extent to throw the industry into the same status of demoralization as it now finds itself.

Mr. Pogue said that while he had not yet made a personal visit to the scene activity in West Texas, that he was "astonished to learn that operators were actually building steel storage to care for production from this district!" He said that from his sources of information he had learned that it costs approximately 40 cents per barrel to build tanks to handle West Texas oil, which, if present development continues, he does not think will have a posted price of more than 50 cents.

Before coming to Fort Worth, Mr. Pogue said that he had made a hurried trip through the Seminole area and was gratified to find that production in this section was showing a material decline. He humorously characterized the 1927 production disaster as the "Seminole Follies," and submitted figures to show the relative loss suffered by the industry generally from the discovery and exploitation of the latest Oklahoma field. He said that while it was estimated that $100,000,000 had been spent developing Seminole, and that possibly 100,000,000 barrels of oil had been removed from the field, thus indicating that operators had broken even in so far as Seminole was concerned, this was not the whole story. The demand for petroleum in 1927, it was pointed out, will reach in round figures one billion barrels and this oil as a result of excess production at Seminole will have sold for a price of approximately $1.00 a barrel less than the prevailing price in 1926. This would represent a loss of one billion dollars to the industry, which, if cut in half, to be conservative, as Mr. Pogue said, would still emphasize the effect on the industry of excess production that results from a development like Seminole.

Looking at the oil industry from a national standpoint, Mr. Pogue said that he has observed a remarkable increase during the past few years in the progress of production engineering and chemical engineering. This has resulted in the industry being able to produce more oil at less cost and to manufacture through cracking a larger amount of consumable product from each barrel of oil, thus adding materially to the avaliable supply. However, it was observed, that this progress in technology had not extended to the economic development of the industry with the result that at present the industry finds itself without economic control over itself. In Mr. Pogue's opinion it is imperative that the industry through its organization, the American Petroleum Institute, take immediate steps toward regaining this control through the development of additional markets and uses for petroleum and its products. This, he said, was strictly a matter for the attention of the executives.

J. D. Collett, president of the Texas Division of the Mid-Continent Oil and Gas Association, made a brief address before the smoker in which he urged the engineer to take full advantage of the practical experience of many of his co-workers at the wheel, which he stressed was in reality the basis for most of their work. He also said that engineers should keep in mind that the industry would depend upon them to lead it in the ways of most economical operation as well as the most successful from a conservation standpoint.

Other speakers contributing to the evening's pleasure were: J. Elmer Thomas of Fort Worth, E. DeGolyer of New York and John M. Lovejoy, chairman of the Petroleum Division.

Production in Archer County Sold.

Wichita Falls.—Announcement was made this week that Shaw & Rathke and Maer & Staniforth sold their joint holdings in Archer County for $400,000.

Property involved included 60 acres on which are located 17 producing wells with a daily average output of 800 barrels.

The land is located on the Day Land and Cattle Company survey, and is a part of the L. F. Wilson ranch.

Dr. Douglas R. Semms, petroleum geologist of Cisco, Texas, has joined the staff of the Geological Survey of Alabama in order to assist in revising bulletins on Alabama's petroleum possibilities. He was formerly professor of geology and mineralogy at the University of Alabama.

F. H. Lahee, chief geologist of the Sun Oil Company, returned to Dallas October 8 from a two months' business and vacation trip in Europe.

Engineers Stress Need for More Definite Data on Gas Lift

FORT WORTH—Engineering and research in the oil industry definitely established its position of importance here last Wednesday and Thursday, when executives, production men and engineers gathered for an open and frank discussion of recent developments in production engineering. Steps were taken to broaden the scope of technical activity in the industry while widespread discussion by those present of subjects of current importance developed a fund of valuable data.

The two-day meeting was held under the auspices of the Petroleum Division of the American Institute of Mining and Metallurgical Engineers and attendance at the various sessions represented the industry from all sections of the country. There were more than 300 registered members and guests, while it is estimated that an additional 100 were present who did not register.

The quantity of available data on subjects of comparative recent interest, as indicated by the variety of discussion following the presentation of the several technical papers, was evidence of the remarkable progress made during the past few years through the application of engineering to production and exploration problems.

The subject of air-gas lift was of paramount interest at the meeting and much of the time was used in the discussion following the several prepared papers on this subject. Of particular importance at these discussions were the outlines developed for future research and the new aspect given to the relation of gas-oil ratios to ultimate recovery. In two of the papers on the subject, which are printed in full elsewhere in this issue, it was shown by recent research that the gas-oil ratio can no longer be used as an absolute index to production efficiency, without taking into consideration the other contributing factors by which it is influenced to an important degree.

The enthusiasm aroused by these papers and discussions prompted many questions which emphasized the need for more definite information along these lines which in the opinion of those present can only be gained from an extensive experimental work. A number of means of providing this experimental work were suggested and it is expected that some co-operative work will be sponsored by the engineers in the near future.

J. M. Lovejoy, chairman of the Petroleum Division of the American Institute of Mining and Metallurgical Engineers was given the authority by a vote of the members to appoint a committee and to act as chairman for the purpose of drafting a resolution to Herbert Hoover, Secretary of Commerce, urging that a larger budget be provided for the Bureau of Mines in order that this body can widen its scope of activity and thus offer an opportunity for the study of a number of additional subjects which at present are not included in its activity. The Bureau was highly complimented for the valuable assistance it has given the industry through its experimental work and it is hoped that this work can be further extended, at least in proportion to technical advancement within the industry itself, according to members of the Petroleum Division.

The committee recently appointed by the Institute to consider definition for technical terms made a report at the meeting and it is expected that a glossary will eventually be compiled by this body that should be of material value in overcoming the confusion now often experienced by difference of meaning of the various terms used in technical discussions.

This committee is composed of A. C. Rubel, Petroleum Engineer of the Union Oil Company of California, Los Angeles, California; L. C. Uren, Professor of Petroleum Engineering, University of California, Berkeley, California, A. W. Ambrose, Manager of Production, Empire Companies, Bartlesville, Oklahoma. An addition to the committee was made at this meeting by the appointment of Van A. Mills, Petroleum Engineer, Bureau of Mines, Bartlesville, Oklahoma.

A tentative program announced for the annual meeting of the Institute in New York in February included a Review of New Facts in Gas-Lift and Gas Oil Ratios; Proper Well Spacing; The Repressuring of Oil Sands; Bottom Hole Datum; Methods and Practice of Water Flooding; Handling Long Strings of Pipe in Deep Drilling, and Well Survey Technique.

North and Central West Texas Has Quiet Period; Drilling on Inside Locations

Fort Worth, Texas.—Throughout the north and Central West Texas districts work generally is slow and most of the activity is confined to inside drilling. Routine completions predominate in all the old areas.

Brown County is perhaps as active as any other section in the North and Central West fields. The Rosenfield pool, Grosvenor district, Brown County, has between 40 and 50 wells drilling. This week 19 completions were shown, 11 of which were failures. E. L. Smith got the best wells on the Smith lease.

Continental Oil Company's No. 1, block 13, Munester pool, Cooke County, is giving promise of making a good producer, and if it does a big scope of new territory will be open to shallow drilling. This test topped the pay at 1373 feet and was drilled in 10 feet, but some difficulty was met in getting a casing seat. The well was cemented and operators were waiting on the cement to set early in the week.

A joint test of the Consolidated Oil Company and the Continental on the Netherton land, section 95, A. T. N. C. L. survey, Archer County, was standing with considerable oil in the hole, according to field reports. Sand depths were reported at 1549 to 1550 feet. Casing was being set and plans being made to drill in as soon as possible. This well is a wildcat and a successful producer would mean considerable play in the new territory.

A number of new locations were announced, scattered over most of the North Texas pools.

Orange Workover Has Flow; Showing Water

Houston.—Rycade Oil Corporation late last week completed its Cow Bayou B-11 at Orange for an initial flow of 1500 barrels through a one-half inch choke, the depth of the hole being 4188 feet. It was the largest well completed in the field for a good many months.

This was an old well that had been deepened. It is located in the central part of the old field.

When it was brought in last week the production was pipe line oil, but several days later it was about 20 per cent salt water, the amount of fluid remaining about the same.

There were three other completions in the Orange field during the past week: Gulf Production Company's Hager Fee 19, a 95-barrel well at 4200 feet, and two failures, Rex Petroleum Company's Cargello 6, depth 3550 feet, and Texhoma Oil Company's Chesson 8, 3050 feet deep.

PROCEEDINGS OF FORT WORTH ENGINEERING MEET
Petroleum Division of the American Institute of Mining and Metallurgical Engineers

On the following pages will be found a digest of the several technical symposiums held at the meeting of engineers in Fort Worth on October 19-20 under the auspices of the Petroleum Division of the American Institute of Mining and Metallurgical Engineers

Symposium on Principles Underlying The Air-Gas Lift

Principles Underlying the Air-Gas Lift

By H. R. PIERCE AND J. O. LEWIS

H. R. PIERCE and J. O. Lewis, in their paper, "Principles of the Air-Lift as Applied to Oil Production," call attention to claims made as to the use and benefits of the gas-lifts, some of which are reasonable, but many of which are unreasonable. The authors also state that a review of the literature discloses many valuable articles on the subject, but there have also been found basic errors in the sources of data upon which conclusions have been predicated, a fact which tends to throw an element of doubt on much of the compiled data.

Accordingly the writers have "concluded that at this time it would be opportune to direct discussion to the sources of error in the data now being collected, to recommend for consideration by the engineers some methods of collecting and collating data, and to point out some of the factors relating to the application of the air-lift principle to oil production as dictated by the different economic ends sought and the limitations of working conditions that may be met."

Ends sought in applying the air-lift must always be practical and not theoretical, though in arriving at a satisfactory solution of the practical end, it is necessary to have correct guiding principles.

Heretofore, most of the conditions to which the air-lift has been applied, had as their first consideration an increase in daily average production to the greatest possible extent, regardless of all else. Seminole illustrates this. A second consideration was cheap lifting costs. Deep crooked holes where it is unpractical to use the old deep well plunger pump has been a third factor in determining the use of gas-lift. Increasing oil recovery as distinct from oil production is the fourth purpose. This last purpose results in a consideration of the effect of back pressure caused by the air-lift upon the expulsion of the oil from the sand as measured by the gas-oil ratio, though the ratio of volume of gas to oil alone is not a correct criterion of measuring recovery efficiency.

Practical Limitations

Definite practical limitations are met with in working out the ends sought. For instance, the size of the casing limits the size of tapered tubing. Backpressure, the occurrence of water with the oil, the emulsibility of the oil with the water, size of well equipment already on the ground, relation of the air-lift to gasoline extraction, rock pressure and natural gas volume, and various other factors will have their influence.

Theory of gas-lift was explained by means of a drawing showing a U-tube, one arm of which represented the submergence, the other the eduction or flow tube. This apparatus showed that the gas-lift consists of a balancing and proportioning of parts, pressures and volumes. For a continuous air-lift, the necessary elements are a pressure that will feed in the liquid to be lifted against the lift pressure and an equal pressure to feed in the air or other gas the liquid pressure confining the gas pressure and directing its flow upward. The volume of the gas, together with the pressure, must equal the foot pounds of energy to lift the liquid against the frictional resistance and after the waste of energy caused by slippage or drop back of the water in the upflowing column.

In a naturally flowing oil well, the oil is fed into the bottom of the hole by means of the gas pressure and there is sufficient volume and pressure of gas to make a natural air-lift from the bottom of the well to the surface, but when the volume or pressure of the gas becomes insufficient, it is necessary to add additional quantities of gas or air from the surface.

Elements Consuming Energy

The three main elements consuming energy in the eduction of the liquid are (1) the weight of oil and the distance lifted, (2) the frictional resistance of the upward moving column of oil and gas, and (3) the slippage or dropback of the oil in the upward flowing gas. The first represents the useful work to be done, and is irreducible, hence efforts to increase mechanical efficiency must be directed to decreasing friction and slippage.

Friction increases with velocity, according to well known laws, but in the air-lift it is difficult to determine a friction constant for a well, and as there is an acceleration of velocity from the bottom to the top of the flow pipe, the computation of total friction is an involved problem.

It is brought out that the fundamental laws governing the volume of gas at different pressures and the work available in gas due to its state, are simple, but the methods of directing these laws, or rather, the arrangement of equipment so that the most benefit is obtained from them is a complicated matter.

Summarizing the complications, the authors set out that we do not have hopes for a complete or definite mathematic analysis of all adaptions of gas-lift to oil production, but we do believe that by the study of all the obtainable factors in any one pool or well, oil can be produced in some instances more efficiently and cheaper by the air-lift method than by any other method. It is also emphasized that many of the claims for gas-lift are rosy, and that in many instances more efficiency could be had by a careful analysis at regular periods on the various wells on a lease.

The authors list information on how to collect and analyze data for a well in a pool on which the gas-lift has not been tried or experience factors set up. (*See complete paper published elsewhere in this issue.*)

Pressures

Extensive experiments with the air-lift in raising water has disclosed that for each depth, size of pipe, and the quantity of fluid to be lifted, there is a certain pressure and volume which

will give the greatest efficiency of lift. If the pressure is exceeded, less air volume will be used, but the total horsepower will be increased and similarly, if a lesser pressure is used, more air is needed, and the total horsepower consumed is greater.

The percentage of submergence or the relative pressure to the height of the lift is greatest in the shallow wells and becomes less and less with increasing depth of the well, though the maximum efficiency obtainable likewise becomes very much less with deep wells.

In the oil fields the pressure and volume used will result not only from the consideration of the maximum efficiency obtainable but also from consideration of the ends desired and the practical limitations; for example, if it is desired to get the maximum daily production, efficiency would be given little weight and all efforts would be directed toward increasing the rapidity of flow to the point where increasing friction placed a limit on the capacities of the eduction pipe. In another case it might be desired to hold a considerable back pressure on the well which might exceed the pressure of maximum efficiency, and in still other cases the declining rock pressure will necessitate the use of flowing pressures much below the air pressure of maximum efficiency. In each well the use of the air-lift goes through a series of changes often starting above the pressure of maximum efficiency and finally ending at a pressure so far below the most efficient that an air-lift becomes unusable as a continuous process.

Depth of the well has a relation to both volume and pressure inasmuch as more foot pounds work will be needed to lift the fluid the greater height, and also as friction and velocity will necessarily increase with the longer flow.

Pipe Size

Size of pipe also has an influence on the pressure and volume of air needed. A pipe of large cross section relative to the amount of fluid to be lifted will reduce friction but increase slippage and necessitate excess volume of air. On the other hand, too small a pipe will cause excessive friction and result in high pressures with low efficiency.

It may thus be seen that the pressures and volumes for maximum efficiency relate to the height of the lift and to the cross section of the pipe relative to the volume being lifted. For each condition of depth and cross section of pipe and relative quantity of fluid to be lifted, there is a certain relation of volume and pressure that will give the greatest efficiency, but the engineer applying the air-lift in the oil fields should not only know how to estimate the point of greatest efficiency but also how to best meet other conditions; such as low rock pressure, or how to get the greatest daily production from a large well if that is desired.

Use of tubing tapered downward is based upon the fact that as a gas approaches the top of a well the pressure becomes less and it expands and flows with increasing rapidity, thus greatly increasing the velocity.

To design a tube so there would be a constant velocity from top to bottom would mean that the cross section of the tube should be increased upwardly in proportion to the expansion of the gas, but this is impossible in deep wells, and in fact would not be theoretically efficient because it would make for extreme slippage. The design must therefore be a compromise between slippage and friction, and the downward tapering of the tubing must be based on an intermediate factor so that the most efficient design will be one with an increasing velocity upward, but at not such a rate as in a straight pipe

As the well gets smaller so that less volume need be handled, then it will become possible to use tapered tubing effectively and this will result in a greater mechanical efficiency, if properly designed and also lower back pressures at the bottom of the well.

Frictional Resistance

The value of reducing frictional resistance at the top of the well by having large flow lines and separating the gas from the oil as close to the well as possible is exceedingly important. For example, if the flowing pressure is 20 atmospheres and the pressure at top of the flow column in one case is four atmospheres, and in the other case two atmospheres, the expansion in the first instance is five times and in the second instance 10 times with a resultant doubling in energy delivered. Of course, the useful work delivered is not doubled because of the increased velocity, but the over all efficiency in almost every case will be increased considerably by keeping down the top pressures which can be effected by proper design of surface flow equipment.

Additional efficiency factors include size of air and flow pipe, design of the foot pieces, air ejection, the relative merits of annular and tubular flowing, the solubilities of air and gas and their relative advantages, in the use of booster holes, intermittent air-lifts, and others.

In discussing the merits of the gas-oil ratio as a measure of efficiency in a flowing well, the authors point out that the gas-oil ratio is a measure of efficiency only where other conditions are the same, and that finally efficiency comes down to a matter of both pressure and volume of gas; in other words, the oil represents the useful work done by the energy contained by the gas, which should be measured by volume and pressure in terms of horsepower or foot pounds of work.

The value of the gas-oil ratio is that it provides a simple and practicably usable means of measuring the sum of the results from the complex relation of many factors underground and in the well, which includes the pressure, nature, and volume of the gas, the distance the gas and oil have to travel to the hole, the resistance of movement of the oil through the sand by reason of friction, viscosity, adhesiveness to the sand grains, and other factors which consume or waste energy.

In their conclusion the writers state that as far as they can see the air-lift has two effects on the efficiency of oil recovery; one, by reason of changes of back pressure against the sand and the other by reason of its effect upon the condition at the bottom of the hole. The last factor is comparatively of less importance, and therefore will simply be covered by stating that the gas-lift tends to remove the sand, mud, and other matter from the hole, thus keeping the hole clean.

Handling Recirculated Gas

By R. D. GIBBS AND C. C. TAYLOR

HANDLING recirculated gas, discussed in a paper by R. D. Gibbs and C. C. Taylor, aids in making the gas production curve of a field assume a long gradual decline and in giving a large volume of gas for treatment for several years to come.

Complex distributing systems are necessary for the proper re-circulating. These include regulating systems as well as large treating and compression plants.

Traps must be of sufficient size to efficiently separate large quantities of gas and oil and should be elevated sufficiently high to enable oil to flow to the gauge tanks under its own head.

Gathering and distributing lines should be large enough to cut down line drop to a reasonable amount.

A back pressure regulator at the point where excess gas is being sold or blown to the air occupies the key position in a regulating system, since it insures the required pressure and volume throughout the system.

Meters installed on the gas lines to and from each well and to any point in the system where shrinkage is likely to occur, assure an intelligent gas balance each day.

Efficient operations cut down surging difficulties.

It would be supposed that the ex-

tractable gasoline in a formation gas would be in equilibrium with the crude oil from which it originated, and that the introduction of dry gas and the enrichment of that gas with further extractable gasoline would include gasoline fractions of a higher boiling range. It was found in plotting curves of the gallons of gasoline to total barrels of oil and gasoline produced in several fields, the curves follow very closely the gas circulation curve for the same fields.

Many factors should determine the kind of a gasoline plant to install, for extraction purposes. If one wishes to have the proverbial "bird in the hand" safe in the gasoline storage tanks, an absorption plant of sufficient size to treat all of the gas efficiently, must be put in.

Mechanical Installations for Gas-Air Lift: Texas, Other Than Gulf Coast

By E. V. FORAN

E. V. FORAN states in his discussion of mechanical installations of the gas-lift in Texas, other than the Gulf Coast region, that the most important of the many factors which control the ultimate production of oil and gas from a producing formation, is the differential pressure existing between the formation and the well bore. Also, this factor is the one subject to the most control.

In gas-lift production from any given formation, Mr. Foran cites four major factors which govern the magnitude of the differential: They are (1). The depth of the well; (2) type and size of flow tubing; (3) volume of the circulating air or gas, and (4) physical properties of the oil-gas mixture after it has reached the well. The first of these factors is uncontrollable and does not vary. The other three are controllable within certain limits. The degree to which the last three factors can be controlled will entirely govern the length of life of the well while on the lift, the lifting cost, and the daily production. It will also govern to some extent the ultimate production from the wells of leases producing by this method.

In the Texas Panhandle where wells are from 2900 to 3200 feet deep, the tubing sizes vary from 2½ inches to a maximum of 4½ inches. Tubing has to be cleaned of paraffin either daily or every other day. Mixed flow strings are not used due to the difficulty of using a scraper in them.

Position of the bottom of the tubing varies. In some cases it is kept at 600 feet above the top of the producing formation; in other instances it is set at a point just above the top of the producing formation.

Working pressures vary from 100 to 225 pounds. Under these conditions the gross gas-oil ratio varies from 2200 to 3500 cubic feet per barrel of oil. The net gas-oil ratio from the sand varies from 200 to 600 cubic feet per barrel. Starting pressures range from 250 to 500 pounds.

Power for compression comes from both gas engines and electric motors.

Rock pressures in the Panhandle lift wells vary from 175 to 400 pounds.

Use in West Texas

During the last six months the air and gas lift has been employed in the Crane-Upton County by the Humble, Tidal, Gulf, Marland, Simms, Landreth and othe companies. In Howard County some preliminary experiments have been conducted, but there are no permanent plants there yet. In the Noodle Creek field, Jones County, Marland has been operating by gas-lift methods during the last eight months.

In the McCamey area success has been limited and marked by many interruptions, due to the presence of troublesome hydrogen sulphide gas.

The Church and Fields University pool, Crane County, is the most active area of gas-lift in Texas at this time.

All plants in this field have compressors capable of delivering gas for starting pressures as high as 600 pounds, and in some cases, 1000 pounds. Volume-control meters are installed in nearly all cases where gas is being delivered from a high-pressure header to several wells which require different input pressures. Air is used to flow the wells, as there is insufficient gas for this purpose. Not all of the gas-lift wells are equipped with meters to measure the wells' output gas.

Tubing sizes vary from 2½ to four inches. Gross gas-oil ratio in this pool is low, the majority of the wells averaging from 700 to 1100 feet per barrel. Input casinghead pressures, on the other hand, are rather high, from 150 to 215 pounds. Some of the wells making around 400 barrels have high working pressures, as high as 175 pounds.

Tubing position in these wells ranges from 250 feet to as high as 550 feet off bottom, due to high starting pressures.

In Jones County, Marland made a radical departure from conventional tubing sizes by installing 5 3/16-inch

(Continued on page 64)

California Practice

By H. C. MILLER

GAS lift has made it possible to recover many thousands of barrels of oil from deep wells in California that could never have been produced otherwise, according to H. C. Miller, in his paper on "Mechanical Installations for Gas-Lift Pumping as Practiced in the Cailfornia Oil Fields."

Usual procedure in California is to introduce the compressed gas at the casinghead. Oil is produced through the tubing.

Normal working pressures of 125 to 275 pounds per square inch for lifts of 4000 feet are common in California.

Starting pressures are usually from two to five times higher than normal operating pressures.

The average gas volume required for producing from 3800 to 4500 feet is somewhere between 1200 and 1500 cubic feet.

Portable and semi-portable installations are common. Most of the permanent installations were built primarily for furnishing compressed air in gasoline plants, before gas-lift pumping became common.

The intermittent or impulse system of flowing a number of wells from a single compressor plant of limited capacity is practiced to some extent.

Automatic and hand controls are used.

Preheating the compressed gas by steam before it enters a gas-lift well, in an ordinary type of heat interchanger has made it possible to flow some of the low-gravity California oils.

Gas traps, elevated so that oil will flow by gravity to the gauge tanks, separate the gas and oil, as in the Mid-Continent.

Pressure and volume-recording devices are on all air or gas lift wells.

Various types of packed casingheads are used in the casinghead or Christmas tree assembly, the most important requirements being that the casinghead be secure against leakage of gas and strong enough to support the string of tubing in the well. Gas connections are usually so arranged that the gas may be introduced through the tubing or between the tubing and the casing. This arrangement allows the well to be rocked.

Existing Information on Gas-Oil Ratios

By LESTER C. UREN

IN HIS PAPER, "The 'Gas Factor' as a Measure of Oil Production Efficiency and the Variables Which Influence It," L. C. Uren points out that the gas factor is a most complex factor, and one which cannot be regarded as an absolute index of production efficiency without due regard to other contributing factors by which it is influenced to an important degree.

He says that the mere recording of a low gas factor obtained through the use of some method or device does not necessarily imply efficiency in oil production; and conversely, a high gas factor does not always signify inefficient recovery. Other variables must also be taken into consideration, and when these are given due weight, it may at times be found that the well producing with a relatively high gas factor is the more efficient.

The fact that the volume of gas at atmospheric pressure which may be produced from a cubic foot of formational gas is a function of the pressure with which the gas is stored in the reservoir sand, seems to have been lost sight of, the author states, by many who indiscriminately compare gas factors obtained from wells of all ages and producing under widely varying field pressures.

If a certain amount of energy is required to force a given volume of oil through the reservoir sand into a well, it is clear that provision of this energy will require the expansion of a larger volume of gas when the field pressure is low, than is necessary when the formational gas exists under relatively higher pressure. Consequently it is natural to expect that the gas factor will range progressively to higher values as the well ages, or as a field is drained of its gas in the normal course of development.

In comparing the efficiencies of different wells, Mr. Uren points out, we are interested not so much in the actual volumes of gas produced with the oil, but rather with the energy consumption represented in the expansion of this gas from the pressure at which it existed in the oil sand. When reduced to the energy basis of comparison, it will often happen, when the efficiencies of two wells are compared, that the one showing the highest gas factor will be producing its oil with a lower unit energy consumption.

In addition to declining formational pressurre, the advancing age of a well is accompanied by the development of oil-drained channels within the more permeable component members of the productive zone, through which gas finds a ready means of escape to the wells. Gas is thereby enabled to pass through the sands from points remote from the wells, without comparable movement of the oil. Oil entering the wells is thus produced in association with gas, only a small portion of which may have had any influence in bringing about its movement through the sand. The gas factor is by this means greatly increased.

The energy necessary to force oil through the reservoir sand over a given distance to a well outlet, will, of course, depend upon the resistance to flow offered by the reservoir sand.

The solubility of gas in petroleum decreases in straight-line relationship with pressure. Accordingly as pressure is released within an oil-bearing formation by production of a part of the oil and gas, much of the remaining gas though originally in solution in the oil, assumes gaseous form and exists within the oil in the form of minute bubbles. While expanding gas bubbles are thus largely responsible for the ejection of petroleum from the sands, it is also true that they interpose considerable resistance to flow. As the pressure declines and the occluded gas bubbles increase in size, the energy necessary to force them through the sand increases.

For a given pessure drop, less energy is consumed if the final or delivery pressure is high than if it is low, for the gas bubbles will have a smaller average size and they will therefore be more easily forced through the sand. If an elevated delivery pressure is maintained, there is a relatively greater percentage of the space within the drainage channels available for movements of oil and consequently more oil flows. This is in all probability why maintenance of back-pressure on a well permits of production of oil with a lower gas factor than is possible when the gas is fully expanded, and explains also why the ultimate production of oil is increased thereby.

For any given conditions there is a certain back-pressure or delivery pressure, which, if maintained, will result in a minimum energy loss and a maximum ultimate oil yield. Determination of this most efficient back-pressure is admittedly a difficult prblem, and even though we are able to determine it precisely for a given well at a particular

Relation of Air-Gas Lift on Gas-Oil Ratios and the Bearing on Ultimate Production:

Data from California

By F. W. LAKE

THAT the ultimate production from a natural reservoir is inversely proportional to the gas-oil ratios existing during the producing life of the reservoir, was stressed in a paper by F. W. Lake, which was largely a summary of experiences encountered in several wells of the Union Oil Company of California.

Mr. Lake further points out that the minimum gas-oil ratio varies widely in different wells, in different areas, in different producing horizons and in the same well at various periods during its producing life. The minimum gas-oil ratio obtainable may vary from as low as a few cubic feet per barrel to as high as several thousand cubic feet per barrel and in each case be a minimum for a certain well at a certain time.

Since for each well, gas-oil ratio control, according to Mr. Lake's paper, lies in the effective back-pressure opposite each of the strata contributing to production, the various methods of production are more or less flexible in furnishing means for changing the effective back-pressure to obtain the minimum gas-oil ratio. In flowing wells it is usually difficult to change tubing diameters and depths and hence two factors remain for the adjustment of the effective back-pressure: (1) the regulation of back-pressure at the tubing head by beans, flowing nipples or trap pressure and (2) the introduction of various amounts of gas in the casinghead similar to gas-lift practice. In pumping wells, the pumping depth, rate of pumping and the pressure held on the casinghead furnish means for the variation of the effective back-pressure to obtain a minimum gas-oil ratio. In gas-lift wells, however, more conditions are introduced, which may be varied to obtian the effective back-pressure resulting in the minimum gas-oil ratio than in any other method of production. It is due to this characteristic of gas-lift operation that lower gas-oil ratios can usually be obtained, because the limits of effective back-pressure variation, which are controlled by the mechanical conditions of actual practice are considerably extended.

In gast-lift operation, Mr. Lake outlines four convenient methods for the control of the effective back-pressure, as: adjustment in tubing diameters, tubing depths, gas volumes and tubing head pressures.

time, it does not remain constant, but continually changes as the formation pressure and volume of oil flow decline.

Application of back pressure to producing wells results in reduction of the gas factor, the volume of gas produced with each barrel of oil decreasing as the back-pressure increases. Up to a certain point this conservation of gas results in increased ultimate recovery, but beyond this point the energy lost in gas not fully expanded, as discharged from the well, exceeds that conserved by reduction of the gas factor and thus the ultimate recovery is diminished. Too low a gas-factor, if obtained by increasing the back-pressure above the critical point, may therefore be indicative of reduced production efficiency rather than the reverse.

Gas energy may be conserved by reducing the rate of production of oil wells, and if a producer is content with a lower production rate, he may, within certain limits, secure a greater ultimate recovery from his property. This would normally be accomplished by applying back-pressure, which would result in a lower gas factor.

Experimental data indicate that due to the radial flow characterictiss of fluids draining into wells, the rate of flow is greatly increased in the immediate vicinity of the walls of the wells. Computations indicate that more than half of the total energy loss in moving oil through sand over a 300 foot drainage radius toward a six-inch well, occurs within 10 feet of the well. Every additional well drilled within the drainage radius of another well thus becomes a center of rapid gas expansion and is therefore to be regarded as a liability in the gas-energy balance sheet. Experiments lend support to the theory that close spacing of wells as represented by "town-lot" development in many Western and Mid-Continent oil fields, is wasteful of gas energy and results in a lower ultimate recovery of oil than would be possible by wider spacing.

There is no doubt but that the production method employed, the degree of well control and general production technic of the operator have an important influence on the gas factor and on gas-energy consumption.

Relation of Air-Gas Lift to Gas-Oil Ratios and Bearing on Ultimate Production:

Data from Mid-Continent

By E. O. BENNETT

E. O. BENNETT, in discussing the effect of the gas lift on the the gas factor and on the ultimate production of an oil well, states that the force causing the flow of fluid into a well when it is drilled into an oil-bearing structure is the pressure differential between the well bore and the formation. A pressure differential between the formation and the well may be set up in there different ways, as follows: (1) Pressure due to gas in solution or in contact with the oil; (2) hydrostatic pressure due to water in contact with the oil (it may be either bottom or edge water); (3) pressure difference due to force of gravity.

The greatest source of energy for producing oil from most oil fields, and the one over which the greatest control can be exerted, is the potential energy in the gas under pressure in the formation.

The amount of energy required to produce a barrel of oil from a well depends on several factors. Some of these factors are controllable and some are not. The controllable factors are: (1) Rate of production; (2) pressure on the formation. The uncontrollable factors are: (1) Porosity of formation; (2) permeability; (3) viscosity of oil; (4) surface tension of oil.

The factor having the greatest effect on the rate and ultimate production of a well is the pressure held upon the producing formation.

In gas lift work little thought has been given to the efficiency of well flow with regards to ultimate recovery.

The gas lift may be called a mechanical means of controlling pressure on the producing formation.

High back-pressures are conducive to steady flow and minimize clean-out costs. High rates of flow cause sanding up of wells, and the closing of the porosity near the well by fine sand and sediment carried along by the oil.

The gas life provides an excellent means of holding back-pressure on a formation. The pressure on the formation is governed by two factors. One is the oil head between the bottom of the tubing and the top of the pay. The other is the working pressure of the input gas. The oil head is governed by the position of the tubing above the formation. The working pressure is governed by the size and length of the flow line and the relative amounts of oil and gas flowing.

Holding back-pressure on gas-lift wells is not generally practiced, but good results may be obtained by so doing.

When considered as a means of back-pressure control, the gas lift may be compared to natural flowing wells under back-pressure. The formation below the flow line is of first importance and is governed by the same factors as a natural flowing well.

When a well, either flowing naturally or by gas lift, is put under pressure control, the production rate for the best results is reduced to 60 to 80 per cent of the open flow of the well. After the differential in the formation is decreased, due to the pressure imposed, the decline rate will be far less than that which will normally occur under open flow conditions. The amount of oil not produced after first applying back-pressure, on account of the decreased rate, is soon regained by the flat decline existing after back-pressure is applied.

The gas lift, properly applied and controlled, will increase the ultimate production of a well. If not properly handled, it will decrease the ultimate production. Proper handling consists principally of the degree of skill practiced in maintaining back-pressure control on the formation.

By proper handling of gas in a gas-lift cycle the gravity of the oil may be raised and the amount lost by outage vapors decreased.

The gas lift can be very effectively used to increase the ultimate production of a field in which bottom water encroachment is encountered. Pressure and flow conditions may be so regulated that back-pressures on the formation sufficient to hold down bottom water coming can be maintained, allowing lateral drainage of oil above the water plane.

Air-Gas Lift Practice at Seminole

By S. F. SHAW

IN SOME fields it has been of advantage to use "beans" or "chokes" in the flow line, thereby securing a high back-pressure, and for a short time conserving the gas, but at Seminole it was pointed out in a paper by S. F. Shaw, the wells in many cases would cease to flow where any form of back-pressure was applied. The lowering of a string of 2 or 2½-inch tubing caused many a large well to cease flowing. The use of a bean is of advantage only where the pressures are high, thus causing the well to act more in the nature of an artesian flow rather than as a gas lift, according to Mr. Shaw, who says that: "in this case the fluid level stands very high and the oil is 'squeezed' through the bean, and pro-

(Continued on page 66)

PROCEEDINGS OF FORT WORTH ENGINEERING MEET
Petroleum Division of the American Institute of Mining and Metallurgical Engineers

Symposium on Handling Congealing Oils and Paraffin

Problems and Their Solution at Amarillo

By W. V. VIETTI

PARAFFIN problems encountered in handling Panhandle crude were detailed by Wm. V. Vietti and Wm. A. Oberlin. In discussing the occurrence of paraffin they say:

"The separation of paraffin from Panhandle crude is localized almost entirely in the flow strings. The amount of paraffin formed varies with each well, but can generally be said to increase with increased gas and decrease with increased oil production. Flow strings, when pulled out of a flowing well (which is flowed by gas entering under the casing), exhibit small amounts of paraffin down to 800 feet. Between 800 and 1200 feet the paraffin thickened, and if not cleaned out, plugged the flow string in this section. From 2000 feet down, the paraffin gradually disappears and the last few joints are practically free from paraffin. Paraffining occurs from the point of entry of gas up to 800 feet from the surface, and even to the surface when excesive amounts of gas are produced with the oil. The separation of paraffin seems to be controlled by the cooling caused by gas expansion."

Swabbing wells show a general paraffin condition throughout the casing.

According to the authors, the gas-lift, and the practice of flowing through tubing have considerably reduced the use of the swab and its attendant evils in the Panhandle. Different conditions were imposed on the wells, and to meet these, better tools were devised to handle the paraffin.

Kerosene has been used as a solvent for paraffin, with some success in increasing production. Kerosene has also been found useful in reducing operating pressures in gas-lift wells.

Increased mechanical efficiency and increased production have resulted by the use of wire line pumps. The whip in the wire line keeps the paraffin from collecting in large amounts in the tubing.

Flow lines are all equipped with heaters made by welding two or more joints of larger pine on the flow line and providing for an inlet and an outlet for steam. Some flow lines are equipped with steam jets welded into the flow line near the well. The periodic injection of steam cleans the paraffin out of the flow line.

Flow tanks, separators and stock tanks are all equipped with steam coils.

The low air and soil temperatures during the winter months forced the Panhandle operators to heat their oil in flow and stock tanks to keep it from congealing and to facilitate treating. Results of experiments on Panhandle crude prove definitely that after heating the crude to 115 degrees Fahrenheit the cold tests regains its original value slowly.

Winter movement of Panhandle crude through lease and various pipe lines had to be carried on with heated oil.

The large viscosity—temperature effect is another important characteristic of Panhandle crude. Panhandle crude at 125 degrees Fahrenheit approaches high gravity Mid-Continent crude in its viscosity. At 50 degrees Fahrenheit the viscosity is comparable to a low gravity asphalt base oil. This thermo-viscosity effect is an added reason for heating the oil for transportation as capacities of the lines are greatly increased.

Very little corrosion of well tubing occurs in the Panhandle. The paraffin coating from the bottom to the top of the tubing acts as a protective and considerably reduces the corrosion to be expected.

[1]This paper appeared in full in The OIL WEEKLY of October 14, 1927, p. 41.

Summary of Existing Information

By C. E. REISTLE[1]

IN summarizing existing information on handling congealing oils and paraffins, C. E. Reistle pointed out that in handling oils of high wax content, three problems may be encountered before the oil reaches the refinery. These are: (1) Precipitation and accumulation of paraffin in the well, either in the oil string or on the face and in the pores of the sand; (2) the accumulation of paraffin and the congealing of oil in the transportation lines; (3) precipitation of paraffin and the formation of tank bottoms.

According to the author, two main factors, possibly three, govern the solubility of wax in crude oil. They are: (1) Temperature, (2) the amount of volatile constituents and gas removed from the crude oil; (3) the presence of water.

Crude oils containing wax congeal when the temperature is sufficiently lowered. This is due to the large number of wax crystals present and also to the fast that the liquid constituents become so viscous that internal friction prevents any free movement of the oil around the wax.

Paraffin deposited in producing wells varies in consistency from a soft, granular semi-fluid, containing considerable oil, to a hard semi-solid wax, containing only a small quantity of oil. Usually some sand, water and inorganic silt is also present. The character of the paraffin depends primarily on the amount of oil present with the wax. This in turn is usually governed by the length of time the wax has been allowed to accumulate in the well.

Paraffin deposits in flowing wells usually extend from the top of the well to a depth of several hundred feet. This lower limit corresponds roughly with the depth at which the earth temperature is the same as the temperature at which the oil is saturated with paraffin, or to the fluid level in wells where the oil rises about this point. Where a large amount of gas is produced, and where excessive cooling takes place, the paraffin often extends somewhat deeper than this.

Heating the oil as it flows from the well by electric heaters is a satisfactory method of preventing paraffin accumulations. Steam is also used for this purpose.

Special tools are used to remove accumulations after they have been deposited. Tools are of two general types: The paraffin knife and flow devil can be used without interfering with the production. The paraffin hook is used where the amount of paraffin is large.

Paraffin accumulations in pumping wells is prevented by keeping the pipe completely full of oil.

Paraffin hooks are used to scrape off the accumulations in pumping wells. Chemicals are also used for this purpose. These generate heat and are usually run into the well between the tubing and casing and allowed to react at the bottom of the hole.

Maintaining the fluid level at the top of the sand prevents paraffin accumulations on the face of the sand. Heaters and solvents are also used for this purpose. Steam is also used.

Heating flow lines prevents paraffin accumulation and also removes paraffin.

(Continued on page 60)

Gas Factor as Measure of Oil Production Efficiency

Paper read before Petroleum Division meeting, A. I. M. E., Fort Worth, Texas, October 19-22, 1927

By LESTER C. UREN
Professor of Petroleum Engineering, University of California.

FIELD studies and laboratory research have established the fact that the expulsive force which drives petroleum into wells, from the reservoir sands in which it is stored by nature, is primarily an expression of the energy latent within compressed natural gas dissolved or occluded in, or otherwise associated with the oil. Each barrel of oil produced is forced into the recovery well by the expansive energy of a certain volume of compressed gas, originally stored with the oil in the pores of the reservoir rock; and each cubic foot of gas so produced with the oil and expanded to atmospheric pressure, reduces by so much, the total natural energy available for oil expulsion. So important has this relationship between the volumes of gas and oil produced seemed, that petroleum production technologists have come to regard the "gas-oil ratio," or the "gas factor" as it has been more conveniently termed, as a measure of oil production efficiency. Different methods of oil recovery and production devices are now compared on this basis and estimates of ultimate recovery obtainable through their use are considered by many to be inversely proportional to the values of their respective gas factors.

The writer has been among those who have given support to a widespread movement toward a proper recognition of the significance of the gas factor as a guide in the control of producing oil wells, and does not wish to in any way oppose its more extended application. It seems necessary, however, in view of the almost elemental faith with which the principle of the gas factor has been received in many quarters, to point out that it is a most complex factor, and one which cannot be regarded as an absolute index of production efficiency without due regard to other contributing factors by which it is influenced to an important degree. The mere recording of a low gas factor obtained through the use of some method or device, does not necessarily imply efficiency in oil production; and conversely, a high gas factor does not always signify inefficient recovery. Other variables must also be taken into consideration, and when these are given due weight, it may at times be found that the well producing with a relatively high gas factor is the more efficient. It is the purpose of this paper to review factors which influence the gas-oil ratio, explaining the effect of each, in the hope of arriving at a more complete understanding of the significance and range of application of this useful index of production efficiency.

Influence of Decline of "Field Pressure" on the Gas Factor

It is a fact well known to all, that the volume of gas at atmospheric pressure which may be produced from a cubic foot of formational gas, is a function of the pressure with which the gas is stored in the reservoir sand, and yet this fundamental principle seems to have been lost sight of by many who indiscriminately compare gas factors obtained from wells of all ages and producing under widely varying field pressures. If a certain amount of energy is required to force a given volume of oil through the reservoir sand into a well, it is clear that provision of this energy will require the expansion of a larger volume of gas when the field pressure is low, than is necessary when the formational gas exists under relatively higher pressure. Consequently, it is natural to expect that the gas factor will range progressively to higher values as the well ages, or as a field is drained of its gas in the normal course of development.

In comparing the efficiencies of different wells, we are interested not so much in the actual volumes of gas produced with the oil, but rather with the energy consumption represented in the expansion of this gas from the pressure at which it existed in the oil sand. When reduced to the energy basis of comparison, it will often happen, when the efficiencies of two wells are compared, that the one showing the highest gas factor will be producing its oil with a lower unit energy consumption. For example, suppose that in case No. 1, a well is producing with a gas factor of 1500 cubic feet per barrel from a formation pressure of 250 pounds per square inch; while in No. 2, 1000 cubic feet of gas is produced with each barrel of oil, but the formation pressure is 500 pounds per square inch. Here well No. 2 has the lower gas factor, but is producing its oil with an energy consumption of approximately 2.2 times that of No. 1. It is submitted that a more appropriate basis of efficiency comparison would be the product of the gas-factor by the number of times the volume of the gas has increased in expanding from the formation pressure to that at which its volume is measured.

The Influence of Advancing Age of Wells in Increasing the Gas Factor

In addition to declining formational pressure, the advancing age of a well is accompanied by the development of oil-drained channels within the more permeable component members of the productive zone, through which gas finds a ready means of escape to the wells. Gas is thereby enabled to pass through the sands from points remote from the wells, without comparable movement of the oil. Oil entering the wells is thus produced in association with gas only a small portion of which may have had any influence in bringing about its movement through the sand. The gas factor is by this means greatly increased.

There would seem to be no means of estimating with any degree of accuracy, the extent of gas channeling, though it unquestionably increases with the age of the wells, and with the amount of oil drained from the sands. Intensity of development as exemplified by close-spacing of wells will no doubt also have an important influence in rapidly developing gas channels. Intersection of drainage cones about closely-spaced wells may quickly develop oil-drained channels through which gas is free to migrate over great distances.

If these considerations are valid, the conclusion is inescapable that lapse of time, resulting in partial drainage of oil and greater freedom of movement of gas throughout the productive formation, will lead to gradual increase in the gas-oil ratio of producing oil wells.

Variation of the Gas Factor With Flow Resistance Offered by the Reservoir Sand to Movement of Oil

The energy necessary to force oil through the reservoir sand over a given distance to a well outlet, will of course depend upon the resistance to flow offered by the reservoir sand. Fine-grained sands having small pore spaces and composed largely of angular grains of rough-surfaced minerals, offer materially greater resistance to passage of

oil through them, than coarser and more porous media composed of well rounded smooth-surfaced minerals. The flow resistance is also influenced to an important degree by the viscosity and surface tension of the oil, low values for these properties permitting greater freedom of movement of the oil through the restricted apertures of the reservoir sand.

The resistance to movement offered by the sand,[1] will primarily determine the amount of energy necessary to accomplish expulsion of the oil, though the rate of flow and the distance over which the oil must travel will also be determining factors. High sand resistance resulting from either small size of sand pores, high viscosity of oil, high rate of flow or long transmission distance, will tend toward increase in the gas factor, and vice versa. Any means of reducing the sand resistance to flow of oil and gas, such as forming cavities about the wells within the oil sand, should also be effective in reducing the gas factor. Obviously these physical variables cannot be ignored in estimating the relative efficiencies of producing wells by comparison of their respective gas factors.

The Influence of Release of Gas from Solution in Oil on the Gas Factor

The solubility of gas in petroleum decreases in straight-line relationship with pressure. Accordingly as pressure is released within an oil-bearing formation by production of a part of the oil and gas, much of the remaining gas, though originally in solution in the oil, assumes gaseous form and exists within the oil in the form of minute bubbles. These occluded gas bubbles become trapped within the sand pores and it is by reason of their continued expansion that the oil is ejected. Experimental data indicate that the fluids move through the drainage channels in chains of alternating oil-filaments and gas bubbles, the latter continually expanding due to decline in pressure as they approach the well outlets.

While expanding gas bubbles are thus largely responsible for the ejection of petroleum from the sands, it is also true that they interpose considerable resistance to flow. As each gas bubble passes from pore to pore of the reservoir sand through the restricted communicating channels, it must be subjected to considerable distortion, a requirement which in the aggregate occasions great energy loss.[2] Furthermore, as the pressure declines and the occluded gas bubbles increase in size, the energy necessary to force them through the sand increases.

For a given pressure drop, less energy is consumed if the final or delivery pressure is high than if it is low, for the gas bubbles will have a smaller average size and they will therefore be more easily forced through the sand. If an elevated delivery pressure is maintained, there is a relatively greater percentage of the space within the drainage channels available for movements of oil and consequently more oil flows. This is in all probability why maintenance of back-pressure on a well permits of production of oil with a lower gas factor than is possible when the gas is fully expanded, and explains also why the ultimate production of oil is increased thereby.

It is to be noted, however, that the advantages gained by maintenance of an elevated delivery pressure are offset to some extent by the energy latent within the gas-bubbles not fully expanded on admission to the well. That is, the saving in energy secured by establishing conditions which limit the size of the gas bubbles within the oil, and the energy loss occasioned by permitting them to escape from the oil sand before they are fully expanded, are opposing factors, and maximum efficiency can be secured only by obtaining a proper balance between them. In other words, for any given conditions there is a certain back-pressure or delivery pressure, which, if maintained, will result in a minimum energy loss and a maximum ultimate oil yield.

Experiments conducted under the supervision of the writer have indicated the essential truth of this theory. In these experiments, gas-saturated oil contained within the pores of an unconsolidated sand in a steel pressure tank, was permitted to escape through a miniature well penetrating the shell of the tank. (See Figure 1.) In successive experiments, sand, oil and initial pressure conditions were maintained precisely alike, except that the miniature well was required to discharge the oil under variable, controlled back pressures. Variation in back pressure was obtained by inserting small "beans" or flow plugs having different sized apertures, in the flow line. The rate of oil flow and total yield was accurately measured in each experiment and production graphs constructed which closely resemble production records plotted from actual field data. Figure 2 presents four of the graphs thus secured. The inserted table on Figure 2 indicates the total yield for each of four different sizes of "beans" (i. e., for four different back-pressures) and it will be noted that the 0.1875-inch aperture gave the maximum yield while the smaller and larger apertures resulted in a lower ultimate yield. The most efficient back pressure resulted in an ultimate production of 17 per cent in excess of that which was secured with the least efficient.[3]

The writer has seen comparable field data secured from actual producing wells, which prove without doubt that

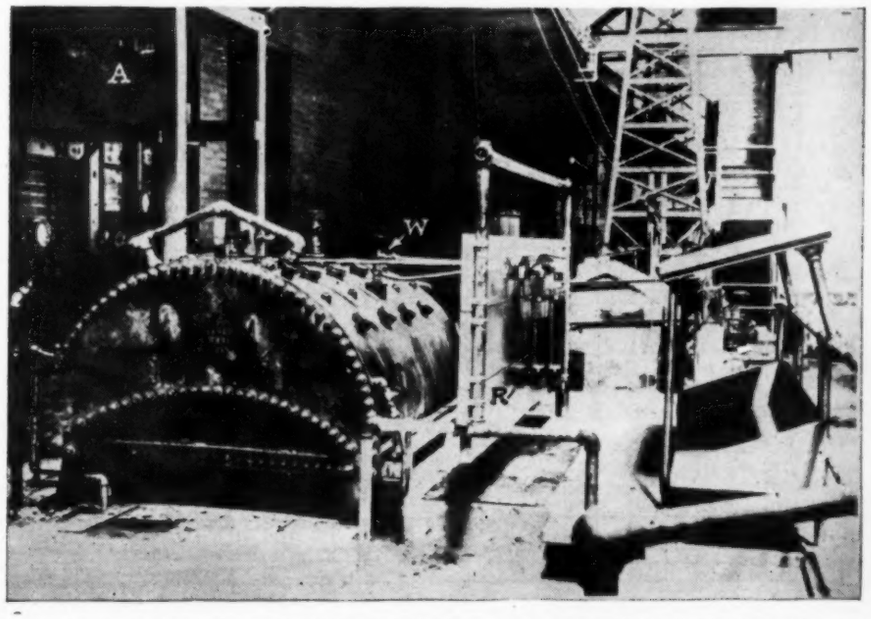


FIGURE 1. PRESSURE-DRAINAGE APPARATUS, PETROLEUM LABORATORY, UNIVERSITY OF CALIFORNIA. A—ABSORBER; T—SAND-FILLED PRESSURE TANK; W—MINIATURE WELL; R—GRADUATED OIL-RECOVERING TUBES.

[1]For a discussion of the forces resisting expulsion of petroleum from reservoir sand, see a paper by the author, printed in National Petroleum News, issue of February 9, 1927, pp 67-76.

[2]For a discussion of the influence of occluded gas bubbles on the movement of oil through reservoir sands, see an article by the author in National Petroleum News, issue of January 26, 1927, pp. 71-79.

[3]The experiments were performed by W. H. Morrison, E. Neal, S. Holmes, and H. Pyle, senior petroleum engineering students in the University of Califonia, with the assistance of Mr. R. S. McIntyre, Instructor in Petroleum Engineering, University of California.

controlled back pressure will result in increased oil recovery, and that there is a certain definite pressure for every set of conditions which will result in maximum yield. Determination of this most efficient back pressure is admittedly a difficult problem, and even though we are able to determine it precisely for a given well at a particular time, it does not remain constant, but continually changes as the formation pressure and volume of oil flow decline.

Application of back pressure to producing wells in reduction of the gas factor, as explained above, the volume of gas produced with each barrel of oil, decreasing as the back-pressure increases. Up to a certain point, this conservation of gas results in increased ultimate recovery, but beyond this point the energy lost in gas not fully expanded, as discharged from the well, exceeds that conserved by reduction of the gas factor, and thus the ultimate recovery is diminished. Too low a gas-factor, if obtained by increasing the back-pressure above the critical point, may therefore be indicative of reduced production efficiency rather than the reverse.

Influence of Recovery Rate on Production Efficiency

Experiments on the resistance offered by sand to the flow of oil containing occluded gas bubbles through its pores, have shown that the resistance to flow varies with some power of the rate of flow in excess of unity. That is, to double the rate of flow, something more than twice as much energy is required. It follows, therefore, that gas energy may be conserved by reducing the rate of production of oil wells, and if a producer is content with a lower production rate, he may, within certain limits, secure a greater ultimate recovery from his property. This would normally be accomplished by applying back-pressure which would result in a lower gas factor.

Influence of Well Spacing on the Gas Factor and on Ultimate Recovery

In a previous section of this paper, it has been shown that gas channeling through oil-drained spaces within the sand is responsible for increase in the gas factor, and that this increase is accelerated as drainage proceeds. Such action is promoted by close spacing of the wells, overlapping drainage cones permitting extensive gas migration over wide areas.

It has also been demonstrated that the energy loss in moving oil through the sand is a function of the rate of flow, increasing as the flow increases. Experimental data indicate that due to the radial flow characteristics of fluids draining into wells, the rate of flow is greatly increased in the immediate vicinity of the walls of the wells. Computations indicate that more than half of the total energy loss in moving oil through sand over a 300 foot drainage radius toward a 6-inch well, occurs within 10 feet of the wall of the well. Every additional well drilled within the drainage radius of another well thus becomes a center of rapid gas expansion and is therefore to be regarded as a liability in the gas-energy balance sheet. Providing the wells are not spaced beyond oil-drainage radius of each other, the fewer the number of wells used, the less rapidly will the oil be drained; and because of the lower average rate of flow of fluids through the sands, the energy consumption per barrel of oil produced will be lower. Hence the ultimate recovery of oil will be greater for widely spaced wells than for closely spaced wells, providing the interval between wells does not exceed the natural radius of oil drainage.

To many this will seem to be a fallacious conclusion, for it is directly contrary to generally accepted belief. The writer, however, has additional proof in the results of a series of experiments conducted in the pressure drainage tank mentioned in a previous section.[5] A group of tests were performed in which the initial sand, oil and pressure conditions were identical, but in which the number of wells used in draining the tank were varied in successive tests. Table I gives the results. Inspection of the data will show that the ultimate recovery decreased steadily as the number of wells increased, except that two wells produced more than one.

TABLE I

Results of Pressure Drainage Tank Experiments to Determine Influence of Well Spacing on Ultimate Recovery

Number of Wells Producing	Total recovery of Oil cu. cm.	Percentage Recovery
1	103,750	25.7
2	117,100	29.0
3	105,700	26.1
4	102,500	25.4
5	101,100	25.0
6	99,300	24.6

Other evidence pointed to the conclusion that a single well did not completely drain the tank, but that two wells were sufficient for the purpose and additional outlets beyond this number, were within oil-drainage radius of each other and were therefore productive of gas wastage and energy loss.

The results of these experiments and the theoretical considerations outlined above, lend support to the theory that close spacing of wells as represented by "town-lot" development in many

(*Continued on page* 61)

[5]These experiments were performed by A. B. Stevens, C. A. Steiner, J. M. De La Garza and A. Bartels, senior petroleum engineering students in the University of California.

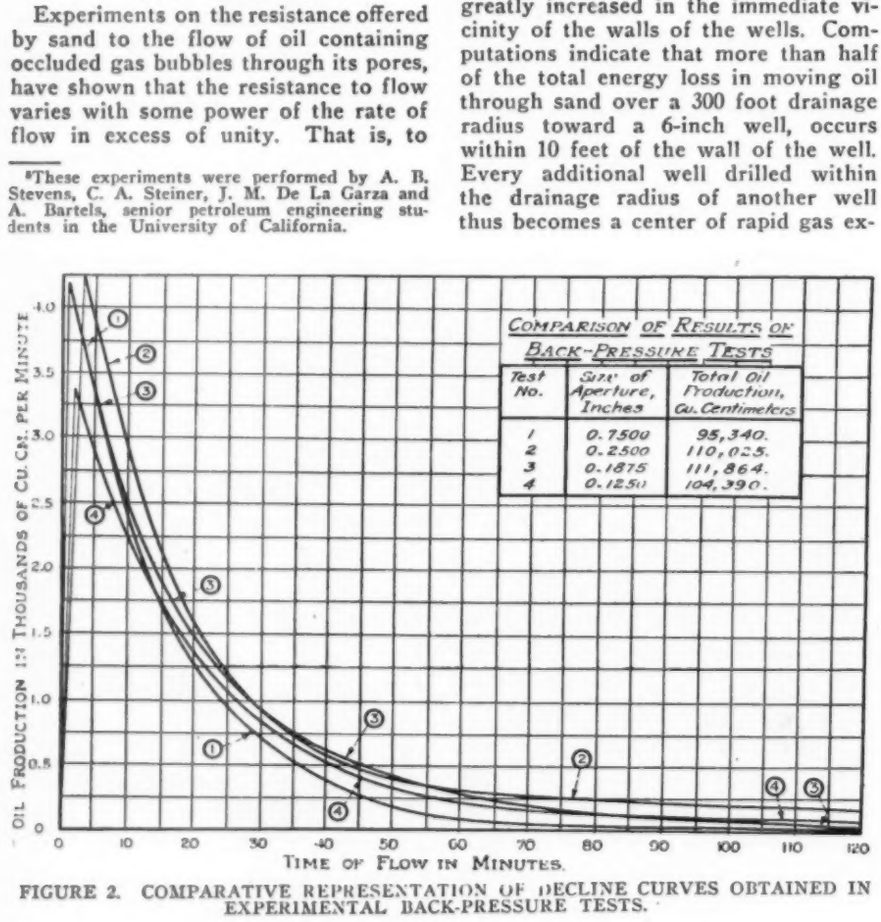


FIGURE 2. COMPARATIVE REPRESENTATION OF DECLINE CURVES OBTAINED IN EXPERIMENTAL BACK-PRESSURE TESTS.

Principles of Air Lift As Applied To Oil Production

Paper read before Petroleum Division meeting, A. I. M. E.
Fort Worth, Texas, October 19-22, 1927

By H. R. PIERCE and JAMES O. LEWIS

SINCE the sudden revival of the air or gas-lift and its extensive use in the oil fields, many questions have arisen as to principles and as to their application under the conditions actually encountered in the field. Much has been written on the subject both as to theory and to practice, especially on the air-lift as applied to lifting water. Many claims have been made as to the use and benefits of the gas-lifts, some of which are reasonable, but many of which are unreasonable, many specialty makers claiming to have devices which operate in almost miraculous ways and even to generate energy nature never possessed. Upon examination these claims are often found to be based upon incomplete or inaccurate data.

A review of the literature discloses many valuable articles and it seems unnecessary for the writers at this time to cover the ground generally, but a review of this literature also discloses the need for setting out more clearly the different practical ends sought and for working out specific engineering principles upon which to formulate the design and operation of gas-lifts to meet the desired ends within the limitations of field conditions. Also a check on some of the published information has disclosed basic errors in the sources of data upon which conclusions have been predicated which, in the minds of the writers, has thrown a general element of doubt as to a large part of the compiled data.

The writers have, therefore, concluded that at this time it would be opportune to direct discussion to the sources of error in the data now being collected, to recommend for consideration by the engineers some methods of collecting and collating data, and to point out some of the factors relating to the application of the air-lift principle to oil production as dictated by the different economic ends sought and the limitations of working conditions that may be met. Until these several considerations are clearly in mind by the engineers and the unreliable data has been sifted out and dependable data substituted, there seems little chance of evolving satisfactory engineering control for the air-lift. In the following pages no distinction will be made between gas and air-lift as they are generically the same.

The Ends Sought

First, let us consider the ends sought in applying the air lift. These will always be practical and not theoretical, though in arriving at a satisfactory solution of a practical end, it is absolutely necessary to have correct guiding principles. Without endeavoring to make a complete outline of the ends sought, we will give the few main considerations and some of the practical limitations:

A review of the conditions to which the air lift has been applied since its introduction a few years ago will disclose that in many instances the primary consideration was to increase the daily production to the greatest possible extent regardless of all else. This is well illustrated at Seminole, where almost the only gauge of efficiency under the highly competitive conditions there was the increase in daily production.

A second consideration was for a cheaper method of lifting the oil—both as to installation and operating costs.

A third consideration was that in the very deep and crooked rotary holes that have been drilled in recent years, it was often unpractical and sometimes even impossible to use the old deep well plunger pump. This problem was the chief reason for the revival of the air-lift in California.

The fourth purpose is the use of the air-lift as a mean of increasing oil recovery as distinct from oil production. This results in a consideration of the effect of the back pressure caused by the air-lift upon the expulsion from of the oil sand as measured by the gas-oil ratio, though as pointed out in the following pages, the ratio of volumes of gas to oil alone is not a correct criterion of measuring recovery efficiency.

In considering these four main ends sought, it is obvious that they will not always be reconcilable and that the design and operation of a gas-lift will differ with the different standards of efficiency. Of course, there will not always be a clear distinction between the ends sought, which often will be a combination of two or more factors, but always the final end will be what the operator thinks the most profitable manner of operation under the existing circumstances. It will be the problem of the engineer to work out and then convince the operator as to what the most profitable manner of operation will be, but to accomplish these purposes the engineer must be well fortified with the data which will enable him to design and operate his apparatus so as to fit the specific need most satisfactorily.

Practical Limitations

In working out these problems the engineer will be faced usually with very definite practical limitations. For example, in the use of tapered tubing, the engineer will be limited to the size of the casing and he will be unable to use the graduations of flow pipe which would otherwise give the best results for a well to which the air-lift is being applied.

There will also be many other limitations; such as the back pressure, the occurrence of water with the oil, and the emulsibility of the oil with the water, the size of the well equipment already on the ground, the relation of the air-lift to gasoline extraction, the rock pressure and natural gas volume, whether or not the lift can be made continuous or intermittent, and many other factors which need not be mentioned here as our primary purpose is illustrative and not enumerative.

But the main point is that theory must finally be adopted to the practical needs and what the engineers need are guiding principles and accurately gathered and analyzide data, which will enable the design of the proper installation with the least delay and the least necessity for experimentation.

The Theory of the Air-Lift

The elements of the air-lift are shown in Figure 1[1]. A U-tube is shown, one arm of which represents the submergence, the other the eduction, or flow tube. Water flows continuously into one arm where it reaches a level that counterbalances both the pressure at point of ejection in the flow tube and the pressure of the aerated column above the injection point.

It can be seen at once that the three pressures must be nearly equal at the point of ejection, the weight of the water in the flow tube plus the friction being but slightly less than the weight of the water less the slight friction in the submergence tube and also slightly less than the pressure less the friction in the air-feed-pipe. The water feeds continuously pass the injection point and the air as continuously enters the upward moving column and carries it up and out of the flow pipe under the slightly unbalanced conditions. If the water is fed in more rapidly, more air will be needed to remove it and to maintain the same level in the submergence tube. Pressure failing, the submergence will be increased which will require a higher air pressure, and if the ingress of water is too rapid, it may overcome the air pressure and volume available and fill up both sides of the U-tube stopping the flow. If the water flow is decreased, the submergence will be decreased, and the pressure at the injection

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[1]Figures were on lantern slides displayed at the reading.

point will be decreased likewise, but if the rate of water feed is dropped too low, the air will not lift the water and may pass alone up the flow pipe or water may accumulate in the flow tube and the air pass out through the submergence tube.

It will thus be seen that the air lift consists of a balancing and proportioning of parts, pressures and volumes. For a continuous air-lift, the necessary elements are a pressure that will feed in the liquid to be lifted against the lift pressure and an equal pressure to feed in the air or other gas, the liquid pressure confining the gas pressure and directing its flow upward. The volume of the gas, together with the pressure, must equal the foot pounds of energy to lift the liquid against the frictional resistance and after the waste of energy caused by slippage or drop back of the water in the upflowing column. Thus the air pressure is controlled by the weight and frictional resistance in the flow tube and the volume is controlled by the energy required at the pressure to overcome the weight and friction plus the quantity of air wasted by reason of slippage.

In a naturally flowing oil well, the oil is fed into the bottom of the hole by means of the gas pressure and there is sufficient volume and pressure of gas to make a natural air-lift from the bottom of the well to the surface, but when the volume or pressure of the gas becomes insufficient, then it is necessary to add additional quantities of gas or air from the surface.

Figure 1 is diagramatic and therefore the flow is shown as a series of separate slugs of water, whereas in fact a well designed air-lift would show at the bottom of the well a mixture of finely divided bubbles of gas in the water and near the top, droplets of water in the air. Figure 1 also shows with approximate accuracy the upward expansion of the air and the relative submergence which would be necessary to confine and balance the air injection and flow pressures. The total thickness of the slugs will give the total weight of the column to which must be added the back pressure resulting from friction.

In Figure 2 is shown the principles of the intermittent gas-lift. The fluid accumulates in the bottom of the well or in a chamber at the bottom of the well when the pressure is off the sand and then air pressure is let into the chamber, which forces the fluid down and up into the eduction pipe, a portion of the air passing through an aperture in the pipe and aerating the column above the injection point. The flow continues until the fluid is out of the chamber, whereupon it is necessary to let a new charge of fluid accumulate in the well.

It is apparent in Figure 1 that if the pressure is not maintained in the U-tube, the air will flow up to the U-tube instead of lifting the water. This occurs in an oil well when the rock pressure becomes lower than the lifting pressure. The air or gas backing up into the sand and forcing the oil away from the well instead of lifting it into the well. As a well gets older this condition is met at some point and it becomes necessary to design and operate the air-lift with lower and lower pressures until finally it may become necessary to flow the well intermittently by means of a chamber arranged in some practical manner if the sand is open, though in tight sands the well often will act satisfactorily as a chamber itself. Another, and more desirable alternative, is to maintain rock pressure by injecting air or gas into the sand in nearby wells.

Figure 1 shows how the gas expands upstream in the pipe. The relative spaces between the slugs of water show not only the expansion but the relative velocity of the flow of gas and water. To keep the velocity constant the cross section of the pipe must be increased in proportion to the expansion of the gas. In Figure 3 is shown with approximate accuracy the increase in the cross section of pipe that would be necessary to maintain a constant velocity in the upflow of the water and the air.

Elements of Mechanical Efficiency

The three main elements consuming energy in the education of the liquid are (1) the weight of oil and the distance lifted, (2) the frictional resistance of the upward moving column of oil and gas, and (3) the slippage or dropback of the oil in the upward flowing gas. The first represents the useful work to be done, and, of course, is irreducible, hence, efforts to increase mechanical efficiency must be directed to decreasing friction and slippage.

Friction increases with velocity according to well known laws, but in the air-lift it is difficult to determine a friction constant for a well, and as there is an acceleration of velocity from the bottom to the top of the flow pipe the computation of total friction is an involved problem. This acceleration is graphically shown in Figure 1, in which the relative velocity is shown by the distance between the water slugs. The problem of friction is thus to keep down velocity.

Analyses of air-lift data by graphic and other means indicate that while friction increases with velocity, the slippage decreases with velocity, thus where slippage predominates, friction tends to be the minor quantity and vice verse, so that when we reduce one the other increases and our final problem is in keeping these two factors balanced so that their combined loss is a minimum. The fundamental laws governing the volume of a gas at different pressures, and the work available in gas due to its state, are very simple, but the methods of directing these laws, or rather, the arrangement of our equipment so that we may benefit most, is our complicated problem. These problems are:

(A) 1. The complicated laws governing the variation of friction of flowing gasses and fluids. Although similar, the friction of flowing water or oil, and gasses, are not identical.

2. By the fact that the law governing the flow of either, changes at some critical velocity.

3. By the fact that the relative quantity of gas and oil or water, or all three, are variable in any flowing column; that is, the relation of quantity of gas and oil or gas, oil and water in the rising column varies from top to bottom of the eductor tube.

4. The change of the friction laws of the flowing constituents at some specific velocity.

5. The variation of volume and pressure of the gas, or pistoning, or lightening medium of the column.

(B) The fact that slippage varies with nature of gas and fluid to be lifted, and with the changes in the quantity relation of gas and fluid, and with the state of the gas.

(C) Due to the fact that oil wells are not drilled and cased especially for gas-lifts, and the rock pressures or submergences are not chosen for efficiency alone, but chiefly to allow the greatest quantity of oil to come into the well. Therefore, and as a consequence, producing oil by gas-lift is not merely a gas-lift problem, but is inseparable and really a minor part of the oil production problem, and as a consequence becomes more complicated and involved, due to the limits imposed upon its operation.

As a summation of (A), (B) and (C), we wish to say that the gas-lift in its simplest form has never been thoroughly analyzed or reduced to mathematical calculation. Therefore, we do not have hopes for a complete or definite mathematic analysis of all its adaptions to oil production, but we do believe that by the study of all the obtainable factors in any one pool or well, oil can be produced in some instances more efficiently and cheaper by the air-lift method than by other methods, but we also believe that many of the claims for gas-lift are a little rosy, and that in many cases more efficiency could be had by a careful analysis at regular periods on the various wells on a lease. Although, as we have pointed out before, we do not believe any fixed mathematical analysis can be devised whereby all conditions can be reduced to a common denominator, we do believe that with the combination of experience in various fields on which an intelligent, consistent analysis has been made, much can be done to eliminate the mistakes so common in the application of air-lift to oil production in new or untried wells or pools.

Collecting and Analyzing Evidence

In examining a well in a pool on which the gas-lift has not been tried or experi-

ence factors set up, the data necessary to determine whether a gas-lift would be beneficial are:

(A) General.

1. Depth of sand.
2. Nature of sand or producing formation.
3. If the well flows or had ever flowed naturally, and how long (see *Specific*).
4. Size of hole and how cased.
5. Whether oil was produced by gas or water drive, or the relation of each as near as possible, if both water and gas were the energy expelling the oil.
6. The initial production and relative rate of decline of oil, gas, and water, if any.
7. Present rate of production as compared to other wells in pool similarly located and drilled.

(B) Specific Information.

1. If the well were flowing:

a. Rock pressure of shut-in well.

b. Nature of flow; that is, steady or by heads, etc.

c. Quantity of oil, gas, and water, if any, produced by well against different back pressures held on the head of the well, three tests of this nature as desirable, and the data worked up in the forms hereinafter described.

2. If the well is not flowing:

The quantity of oil and gas that the sand will deliver should be plotted against the head in feet of fluid above the top of the sand; that is, the oil level should be pumped, swabbed, or bailed down to three or more depths, and the quantity of oil and gas produced from these various places tabulated and plotted against pressure head of fluid above the sand, which pressure may be deduced from head and density of column, taking account of gas quantity in the column, gravities of gas, and liquids, etc.

The following data on two wells illustrates the author's methods of working up for comparison the data gathered on flowing wells. From the examination of the data so tabulated, and compared with experience factors and certain fundamental curves prepared to fit in with the experience factors and data, deductions can be made, indicating the present efficiency relation to a deduced possible efficiency of flow under improved methods and conditions.

The gain of such changes as are necessary then may be balanced against the expense and time lost in changes.

Method of Working Up Data for Purposes of Comparison.

	Well 1	Well 2
1. Bbls. oil per day	2860	200
2. Bbls. water per day ..	....	....
3. Total fluid per day (bbls.)	2860	200
4. Total fluid per sec. (cu. ft.)	0.1861	0.0130
5. Gas furnished per day	480 M	650 M
6. Natural gas per day	1,305	185
7. Total gas per day...	1,785	835
8. Total gas per sec (cu. ft.)	20.68	9.67
9. Total gas-oil ratio (cu. ft. per. bbl.)	624	4,175
10. Furnished gas-oil ratio (cu. ft. per bbl.)	168	3,250
11. Natural gas-oil ratio (cu. ft. per bbl.)	456	925
12. Weight total liquid per sec. (lbs.)	9.55	0.68
13. Weight total gas per sec. (lbs.)	1.55	0.72
14. Total weight lifted per sec. (lbs.)	11.10	1.40
15. Depth of tubing ...	4,216	4,108
16. Sumbergence in feet	1,340	264
17. Lift in feet	2,876	3,844
18. Velocity at top in ft/sec.1/2	114.0	41.4
19. Velocity at bottom in ft/sec.1/1	8.44	7.42
20. Difference in Vel. (V_2-V_1)	105.56	33.98
21. P_1 (abs.)	499.4	126.4
22. P_2 corrected (abs.) bottom well	493.0	109.7
23. P_2 corrected (abs.) ..	28.4	19.4
24. $R_1 P_1$	34.23	7.62
$\frac{R_1 P_1}{P_2}$		
25. $R_2 P_1$	17.36	5.66
$\frac{R_2 P_1}{P_2}$		
26. Total work in gas through R_1 ft lbs/sec..	151,500	40,700
27. Total work in gas through R_2 ft lbs/sc. ..	121,750	34,780
28. Total work lifting liquid+gas+acc. ft. lbs. /sec.	33,834	5,407
29. Total work lifting liquid, ft. lbs./sec.....	27,450	2,614
30. Total work lifting gas, ft. lbs./sec.	4,460	2,768
31. Total work lifting acc. liquid+gas ft. lbs./sec...	1,924	25
32. Total work unaccounted for ft. lbs./sec.....	87,916	29,373
33. E_1 Work lifting liquid % $\frac{\text{Work in gas through } R_2}{}$	22.60	7.53
34. E_2 Work lifting gas % $\frac{\text{Work in gas through } R_2}{}$	3.67	7.97
35. E_3 Work of acceleration % $\frac{\text{Work in gas through } R_2}{}$	1.58	.07
36. E_4 Work lifting liquid +gas+acc. % $\frac{\text{Work in gas through } R_2}{}$	27.85	15.57
37. Work Unaccounted for % . $\frac{\text{Work in gas through } R_2}{}$	72.15	84.43

[1]Davis, Geo. Jacob and Weidner, C. E.; An Investigation of the Air-Lift Pump, Bulletin No. 667, University of Wisconsin, 1914.

Pressure and Volume of Air

Extensive experiments with the air-lift in raising water has disclosed that for each depth, size of pipe, and quantity of fluid to be lifted there is a certain pressure and volume which will give the greatest efficiency of lift. If the pressure is exceeded, less air volume will be used, but the total horsepower will be increased and similarly, if a lesser pressure is used more air is needed, and the total horsepower consumed is greater, the results of these experiments disclose a curve of the nature shown in Figure 4, which is taken from a paper by Davis and Weidner[1]. The submergence corresponds to relative pressure.

The precentage of submergence or the relative pressure to the height of the lift is greatest in the shallow wells and becomes less and less with increasing depth of the well, though the maximum efficiency obtainable likewise becomes very much less with deep wells. Thus in Figure 4, for wells of increasing depths there would be a series of similar curves of less output or efficiency, and with the point of maximum efficiency shifting to the left, thus showing decreased submergence or relative pressure.

In the oil fields the pressure and volume used will result not only from the considerations of the maximum efficiency obtainable but also from consideration of the ends desired and the practical limitations; for example, if it is desired to get the maximum daily production, efficiency would be given little weight and all efforts would be directed toward increasing the rapidity of flow to the point where increasing friction placed a limit on the capacities of the eduction pipe. In another case it might be desired to hold a considerable back pressure on the well which might exceed the pressure of maximum efficiency and in still other cases the declining rock pressure will necessitate the use of flowing pressures much below the air pressure of maximum efficiency. In fact, in each well the use of the air-lift goes through a series of changes often starting above the pressure of maximum efficiency and finally ending at a pressure so far below the most efficient that an air-lift becomes unusable as a continuous process.

Depth of the well obviously has a relation to both volume and pressure inasmuch as more foot pounds work will be needed to lift the fluid the greater height, and also as friction and velocity will necessarily increase with the longer flow. This results in the need for greater pressure and volume with depth and in a lower and lower percentage of efficiency as measured by the delivery of useful work.

Size of pipe also has an influence on the pressure and volume of air needed. A pipe of large cross section relative to the amount of fluid to be lifted will reduce friction but increase slippage and necessitate excess volume of air. On the other hand too small a pipe will cause excessive friction and result in high pressures with low efficiency.

It may thus be seen that the pressures and volumes for maximum efficiency relate to the height of the lift and to the cross section of the pipe relative to the volume being lifted. For each condition of depth and cross section of pipe and relative quantity of fluid to be lifted, there is a certain relation of volume and pressure that will give the greatest efficiency, but the engineer applying the air-lift in the oil fields should not only know how to estimate the point of greatest efficiency but also how to best meet other conditions; such as, low rock pressure, or how to get the greatest daily production from a large well if that is desired.

The use of tubing tapered downward is based upon the fact that as a gas ap-

proaches the top of a well the pressure becomes less and it expands and flows with increasing rapidity, thus greatly increasing the velocity. This is shown graphically in Figure 1, which represents a comparatively shallow well. This velocity accelerates to the point that the friction becomes enormous in deep wells. At the bottom of the well, the upward flow of the oil and gas is relatively slow and probably much too slow for efficiency considered from the standpoint of slippage. On the other hand near the top of the well the flow is much too fast considered from the standpoint of friction; therefore, the need is for a design which in effect will increase velocity at the bottom of a well and decrease velocity towards the top.

These considerations, long recognized, have lead to the design of tapered tubing, which has been applied for many years in air-lifting water. The factors to be considered here are the practical design of tapered tubing under conditions met in the oil fields.

To design a tube so there would be a constant velocity from top to bottom would mean that the cross section of the tube should be increased upwardly in proportion to the expansion of the gas as shown in Figure 3, but this is obviously impossible in deep oil wells, and in fact would theoretically not be efficient because it would make for extreme slippage. The design must therefore be a compromise between slippage and friction, and the downward tapering of the tubing must be based on an intermediate factor so that the most efficient design will be one with an increasing velocity upward but at not such a rate as in a straight pipe. In a well, especially a deep well, the use of tapered tubing is necessarily restricted to the size of the casing. There is a limit to the size that can be used at the top and to design a tubing in the correct proportions would make it far too small at the bottom of the well. As a matter of fact, in a well of considerable capacity, it will be found that the use of any tapering can be made only by sacrifice of daily production, as a smaller size of tapered tubing would so restrict the cross section of the pipe as to unduly limit the flow and create high frictional resistance that would result in a high-back pressure. This would be especially true where the end sought is the greatest daily production so that early in the life of the field it may not be practical to use any tapered tubing when the conditions are competitive.

As the well gets smaller so that less volume need be handled, then it will become possible to use tapered tubing effectively and this will result in a greater mechanical efficiency, if properly designed and also lower back pressures at the bottom of the well.

When it comes to deciding on the taper, the engineer will have three problems; first, the practical limitation of the larger size that can be used at the top of the well; secondly, the smallest size that can be used at the bottom of the well to handle the volume of fluid without undue frictional resistance, curtailment of production, or back pressure; and, thirdly, the proper proportioning of the pipe as between the maximum size at the top and minimum size at the bottom. For efficient operations the graduations cannot be made at random because there should be a mathematical relation between the lengths of the different sizes which will evolve the best compromise between the factors of slippage and velocity.

In connection with the use of tapered tubing, it may be pointed out that if this proves of sufficient importance, it would be possible in many instances to case the well with a string of pipe with larger sizes near the top that will permit taking advantage of this principle in deep wells, where the need for it is greatest.

Surface Flow Lines

As the velocity towards the top of the well becomes increasingly greater, the factor of frictional resistance is of even greater moment at the surface of the ground than in the well itself. Shaw has called attention to surface equipment that has been designed to reduce frictional resistance to a minimum and incidentally to reduce the back pressure at the top of the flow column in the well. This is applying correct and acceptable practices which have been used in the lifting of water, where the equipment for separation of air and water has received close attention. The value of reducing frictional resistance at the top of the well by having large flow lines and separating the gas from the oil as close to the well as possible is exceedingly important, as can be shown by theoretical considerations backed by experience; for example, if the flowing pressure is 20 atmospheres and the pressure at the top of the flow column in one case is four atmospheres, and in other case two atmospheres, the expansion in the first instance is five times and in the second instance 10 times with a resultant doubling in energy delivered. Of course, the useful work delivered is not doubled because of the increased velocity but the over all efficiency in almost every case will be increased considerably by keeping down the top pressures which can be effected by proper design of surface flow equipment. The reduction in flow pressure is likewise reduced to an important extent.

Other Factors Relating to Efficiency

In addition to the factors discussed on the efficiency of the air-lift are many others, of which space will not permit more than mention. These include sizes of air and flow pipe, designs of foot pieces, air ejection, the relative merits of annular and tubular flowing, the solubilities of air and gas and their relative advantages, the use of booster holes, intermittent air-lifts, and many others. As to these factors but a few points can be made.

The air pipe can always be smaller than the flow pipe, yet there can be a surprising loss in pressure in deep wells in small air pipes which should be guarded against. To handle much fluid the flow pipe should be large, but if there is little fluid the slippage losses will be excessive and in fact the air-lift may be inoperative. Where the fluid becomes small tapered tubing should be used. Whether to use the central pipe as the air or flow pipe is mostly a practical matter as to the quantity of fluid to be flowed, corrosion problems, and so on. Foot pieces have been elaborately investigated and found to have but small influence on efficiency. The values of different designs of the air injectors have also been exaggerated. Too little reliable and comparative data has come to the writers' attention as to the relative merits of gas and air to warrant the expression of any opinions. The intermittent air-lifts involve more practical differences than theoretical differences.

Gas-Oil Ratio

There has been much interest displayed as to the effect of the air-lift upon oil recovery. The evidence considered has been curves showing the decline before and after the application of the lift and data showing the difference between the gas-oil ratios before and after use of the lift. Evidence and opinions have differed and a general confusion is apparent as to both principles and results. The misunderstanding as to the use and significance of the gas-oil ratio is especially notable therefore it has been deemed advisable to set out what the writers believe to be the correct principles and use of this factor.

Some years ago the junior author[3] suggested the use of the volume of gas compared to the volume of oil as the medium of recovery efficiency, which since, has been commonly termed the "gas-oil ratio" or "gas factor," but in applying this principle some of the fundamental elements have apparently been entirely overlooked, one of which is that the gas-oil ratio is a measure of relative efficiency where other conditions are the same, and, secondly, that efficiency finally comes down to a matter of both pressure and volume of gas; that is, to the energy contained in the compressed gas which expells the oil. In the volumnous discussions of gas-oil ratios, we have seen no consideration of the fundamental principle, which is that the oil represents the useful work done by the energy contained by the gas, which should be measured by volume and pressure in terms of horse power or foot pounds of work.

As a practical thing, however, the gas-

(*Continued on page* 56)

[3]Lewis, James O., Bulletin No. 148, page 118, U. S. Bureau of Mines, 1916.

Effect of Gas Lift on Gas Factor And Ultimate Recovery

Paper read before Petroleum Division meeting, A. I. M. E., Fort Worth, Texas, October 19-22, 1927

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WHEN oil is taken from a subsurface structure it is generally accompanied by gas. The gas thus produced represents those lighter hydrocarbons present in the original petroleum accumulation but which are insoluble at the reduced pressures created around a well when it is producing. In some cases the gas accompanying the oil may come from a gas-bearing stratum not in immediate contact with the oil. The amount of gas from the formation accompanying each barrel of oil is called the natural gas factor.

Energy Causing Well to Flow

The force causing the flow of fluid into a well when it is drilled into an oil-bearing structure is the pressure differential between the well bore and the formation. A pressure differential between the formation and the well may be set up in three different ways as follows: (1) Pressure due to gas in solution or in contact with the oil, (2) hydrostatic pressure due to water in contact with the oil (it may be either bottom or edge water); (3) pressure difference due to force of gravity.

The greatest source of energy for producing oil from most oil fields, and the one over which the greatest control can be exerted, is the potential energy in the gas under pressure in the formation. In any pool there is but a definite amount of gas available. Part of this gas may be in solution and a part in contact with oil. The amount of gas in solution in each barrel of oil depends on the pressure and temperature in the formation and the characteristics of the oil. Whether the gas is in solution or in contact with the oil it is necessary to use the energy it contains as efficiently as possible in order to obtain the greatest ultimate recovery from the pool.

Bush[1] states:

"Gas being the most efficient aid in moving the oil, it is important to prevent more of it from escaping than is necessary to remove the maximum amount of oil from the sands. The conservation of this energy is far more important to the producer of oil than his returns from sales of gas to distributing companies. The flowing life of the well is the most profitable period, and keeping the gas-oil ratio low, or keeping the gas in solution as long as possible, prolongs the flowing life of the well and moves more oil from distant parts of the sand, thereby increasing the total ultimate recovery of a property or field. Laboratory experiments have proved that the viscosity of oil is greatly reduced with gas in solution, and when this gas is under several hundred pounds pressure, the viscosity of the oil tested was said to be about the same as that of gasoline. When the gas escapes the viscosity increases, and oil is left in the sand to be recovered only by expensive methods and at a very slow rate."

The amount of energy required to produce a barrel of oil from a well depends on several factors. Some of these factors are controllable and some are not. The controllable factors are: (1) Rate of production; (2) pressure on the formation. The uncontrollable factors are: (1) Porosity of formation; (2) Permeability; (3) viscosity of oil; (4) surface tension of oil.

The factor having the greatest effect on the rate and ultimate production of a well is the pressure held upon the producing formation. The rate at which the energy is dissipated is governed by the flow differential. This, in turn, is controllable over certain limits by back-pressure regulation. Millikan[2] states:

"So high a pressure differential between the sand and the well may exist that the gas will move through the sand at a greater velocity than that at which it will carry the maximum amount of oil. As the pressure declines, the velocity of the gas is reduced and a smaller volume carries with it an equal or greater amount of oil, which results in a declining gas-oil ratio. Under these conditions if the velocity of the gas is reduced by increasing the pressure the amount of oil would be increased and the volume of gas per barrel of oil decreased. Excessive velocity of gas through the sand is affected by the size of the pores in the sand as well as the pressure differential, larger pores permitting an excessive velocity under conditions which would be normal in a finer grained sand."

The gas lift has been given much study and discussion during the past year. It has been used primarily as a means of increasing the output of wells; and but little thought has been given to the efficiency of well flow with regards to ultimate recovery. Most gas or air-lift installations have been put in with the view of getting maximum production and maximum mechanical efficiency in the flow line. But little regard has been given to that part of the well below the flow line. When compared to the efficiency of the well the mechanical efficiency of the flow line is of secondary importance. To strive for mechanical efficiency in the flow line only will generally cause an economic loss in production.

It is true that with a high mechanical efficiency in the flow line a smaller amount of gas is required to raise a barrel of oil than when low efficiency exists. If the amount of gas coming from the formation is ignored, the total production efficiency of the well may be very low even with the very best mechanical efficiency in the flow line. The result of this condition is that while a fair rate of production may exist the well's ultimate recovery will be decreased. Efficient operators equip their wells with meters and gages on the input side. There are, however, very few who measure the discharge gas from the well. The differenle between the output and the input gas is the amount taken from the formation. It is called the natural gas factor. The natural gas factor is the best criterion of the well's condition and should be given the most consideration at all times. A careful study of natural gas factor decline will give very valuable information regarding the ultimate recovery of a well.

The principle involved in applying the gas or air lift to producing an oil well is not new, nor is its application in the oil industry new. Some of its most important features are, however, given but very little consideration. The gas lift may be called a mechanical means of controlling pressure on the producing formation. Under this condition the title of this paper might better be "Back-pressure and Its Effect on Gas Factors and Ultimate Recovery." Before discussing the use of the gas lift and its relation to ultimate recovery, it is advisable to discuss the

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[1] R. D. Bush: Conservation of Gas in the Production of Oil, Publication of California State Mining Bureau (March, 1927) 12, 9.

[2] C. V. Millikan: Gas-Oil Ratio as Related to Oil Production Decline. Petroleum Development and Technology in 1926, 147.

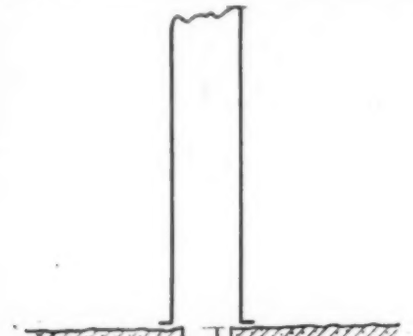

Fig. 1. Showing the condition of the producing formation around the well when the well is first drilled in.

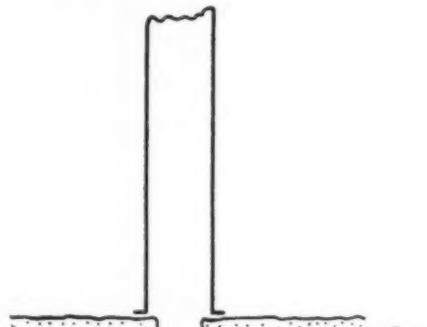

Fig. 2. Represents the condition of the well as production is continued. The space around the bottom of the well is drained of oil and the gas escapes very readily.

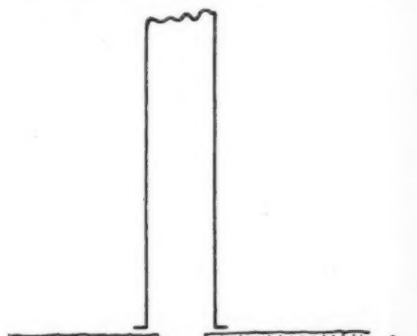

Fig. 3. Showing the condition of saturation around a well which is produced under back-pressure or under a small flowing pressure differential between the well bore and the formation.

effect of pressure on the condition of the sand in the well during different stages of the life of the well.

Figure 1 represents the condition of the producing formation around the well when the well is first drilled in. Approximately all of the gas in the formation is in solution in the oil and the formation is completely saturated. This is also evidenced by the fact that wells flow, where the pressure is suitable, as soon as the bit penetrates the formation. If a well is drilled in and allowed to produce unchecked a maximum differential is created between the formation and the well. This sudden release in pressure allows the gas contained in the oil to escape. Much of the escaping gas gets away without doing any work in moving oil to the bore of the well. The only work it can do then is to assist the oil through the tubing or casing. Such energy can better be supplied from the surface. In Fig. 1 the oil drainage area into the well is: D π x A, where D is the diameter of the well bore and A is the penetration into the producing formation.

Then

$$Q = \frac{AP \times D \times \pi \times A}{R^n} \text{ where}$$

Q=the quantity of oil produced during a definite period of time.

AP=The difference in pressure between the formation and the well. (It is the rock or shut-in pressure minus the back-pressure on the formation.)

R^n=the resistance factor which governs the flow through a sand. It is governed by the porosity and permeability of the formation, the characteristics of the oil, and rate of flow.

When a well is first drilled in ΔP and A are both large and R^n is small. This indicates that, on account of the saturated condition at the well, the oil produced has but a short distance to travel and the production rate will be high. With a maximum saturation, maximum drainage area and low resistance, but little work is required to move oil into the well. The result is that the well fills rapidly and imposes a pressure on the formation, on account of the hydrostatic head created. This pressure then decreases the differential or owing pressure ΔP and keeps the gas dissolved in the oil from escaping at a maximum rate. As long as the flow rate from the well does not exceed the rate of influx into the well, the saturation next to the well will be great and the escape of free gas small. It is for this reason that oil is always produced with lowest gas factors at the flush stage of production.

As production is continued for a period of time the oil must travel farther to get to the well. The resistance to travel from a distance increases very rapidly and the energy required increases in a corresponding amount. This requires more gas per barrel since the pressure and energy contained in each cubic foot of gas also decreases. If the oil is continually removed at a rate approximating the flush stage, it is produced faster than it can enter the well. The result is that the space around the well is drained of oil and allows the gas to escape very readily.

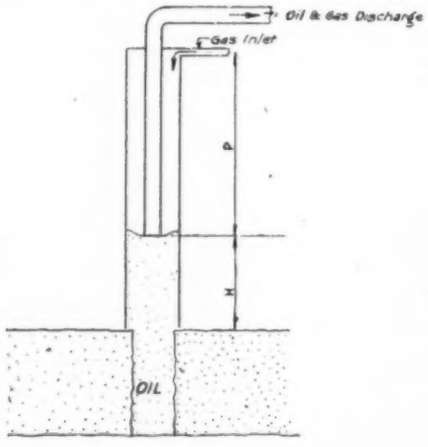

Fig. 4. Diagram to show what controls the pressure on a gas lift well.

This condition is shown in Fig. 2. The upper portion of the formation near the well has been denuded of its oil and a large drained area is left through which gas can escape without moving any oil. The total drainage area for the oil to enter the hole now becomes D π x A1 and since A1 is much less than A there is less opening for oil to flow into the well. The conditions as shown in Fig. 2 can exist where the well is still in its early life, but has been produced at too great a rate. It may also exist during the later life of the well when natural depletion has occurred. The quantity Q as before is $=\Delta P1 \times D \times \pi \times A1$. In this case $\Delta P1$ is large and A1 is small. The product of these two may now be greater than it was in the first case. This would indicate a greater production rate. On account of the increased area for gas bypassing and the increased resistance to the flow of oil on account of the smaller drainage area and greater distance the oil must travel the production actually becomes less and the gas factor increases.

After a well has produced for a short time and the existing pressures are such that it will continue to flow naturally, the amount of gas escaping into the well, which does but little work in moving oil to the bore, is greater than the amount required to aerate the fluid column in the casing to the point

where the pressures are unbalanced and the well flows. The result is that the oil is produced with a very high natural gas factor, a low production efficiency, and the ultimate recovery from the well is decreased.

Fig. 3 shows the condition of saturation around a well which is produced under back-pressure or under a small flowing pressure differential between the well bore and the formation. In the initial stages of a well the sand is completely saturated as shown in Fig. 1. After rapid production the condition of saturation changes to that shown in Fig. 2.

Petroleum as found in a completely saturated formation is a hydrocarbon fluid composed of liquid and gases. When the condition shown in Fig. 2 has been reached and back-pressure is applied to the well the gas, being highly compressible, is affected at a greater rate than the oil. Any increase in back-pressure, or decrease in differential pressure, causes a greater static pressure to exist in the formation at the well bore. This increased pressure which can approach the rock, or shut-in formation pressure, as a maximum, compresses the gas adjacent to the well into a smaller space than it formerly occupied. The same pressure which compresses the gas has but little effect on the volume occupied by the oil, as the oil has characteristics more like a pure liquid.

By holding the gas to a smaller volume, the oil occupies more of the space formerly occupied by the oil and the formation becomes re-saturated. The re-saturation has taken place under a declining flow differential, yet the production will be maintained and sometimes increased. The principal advantage gained is that of reducing the volume of gas produced per barrel of oil with assurance of a greater ultimate yield and lower production costs.

High back-pressures are conducive to steady flow and minimize clean-out costs. High rates of flow cause sanding up of wells, and the closing of the porosity near the well by fine sand and sediment carried along by the oil.

The Gas Lift

The gas lift provides an excellent means of holding back-pressures on a formation. The pressure on the formation is governed by two factors. One is the oil head, H, between the bottom of the tubing and the top of the pay. The other is the working pressure of the input gas. H is governed by the position of the tubing above the formation. The working pressure is governed by the size and length of the flow line and the relative amounts of oil and gas flowing.

When a well is equipped with a gas lift during the time it will still flow naturally the total pressure on the formation should be maintained at as high a point as possible. Small tubing for the flow line can be used to accomplish this or larger tubing with a choke or "bean" at the surface. Holding back-pressure on gas-lift wells is not generally practiced, but good results may be obtained by so doing. Fig. 5 shows the effect of placing a well on the gas lift under pressure control by restricting the flow line at the surface.

The gas lift provides a means of increasing the flow rate of most wells where applied and is generally installed for this purpose. Such practice, however, will not generally give the maximum ultimate recovery.

Fig. 5 shows the production curve of a well that produced first under natural flow with back-pressure, then on the gas lift without pressure control and later by the gas lift under pressure control.

The well declined under flowing conditions as shown during the first three months of its life. The dotted line drawn in is the estimated decline curve of the well under normal conditions. At the end of three months the well was placed on production by the gas lift, and followed the decline shown. The dashed line is the estimated decline while the well was producing on the gas lift. After two months on the gas lift the well was placed on the gas lift under pressure control at the surface and from that time on for the next several months the decline practically stopped. This condition is realized on account of the highly saturated condition existing at the bottom of the hole and the minimizing of the differential between the formation and the well. Whether a well is being produced by the gas lift or is flowing natural, the effect on its ultimate production is controlled by the pressure conditions in the well.

When c sidered as a means of back-pressure control the gas lift may be

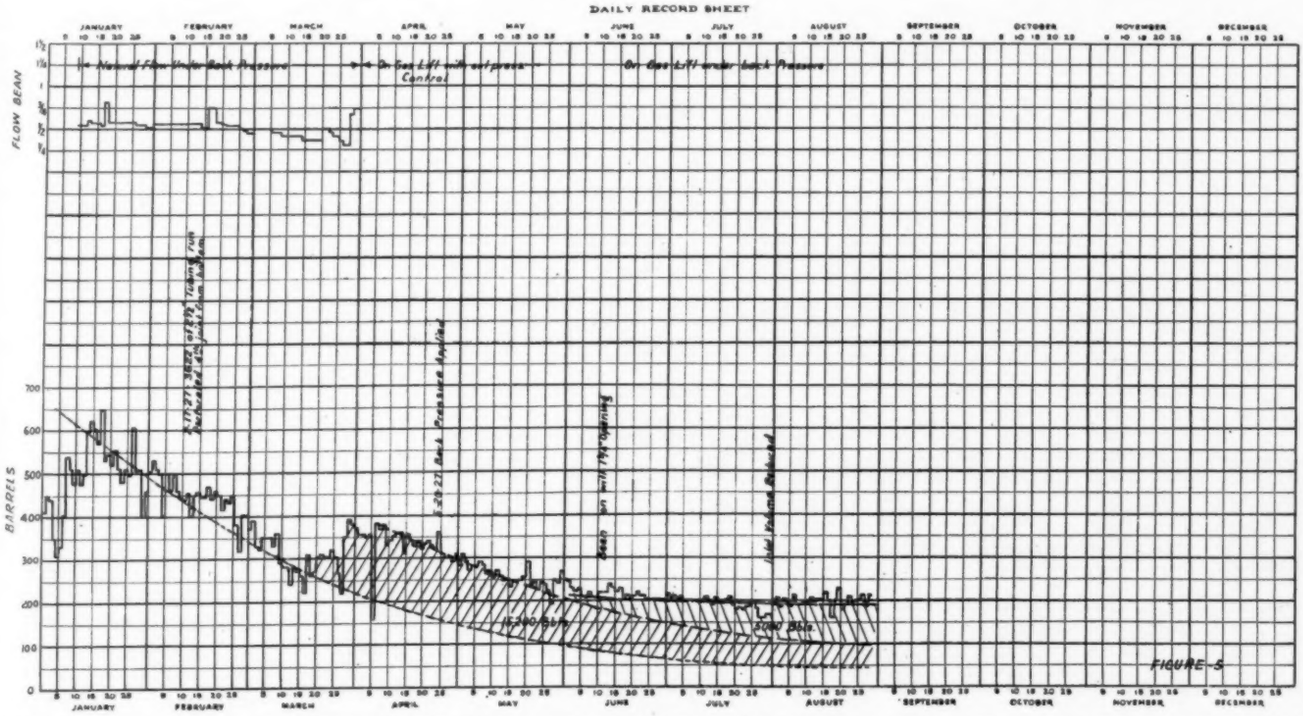

Fig. 5. The production curve of a well that produced first under natural flow with back-pressure, then on the gas lift without pressure control, and later by the gas lift under pressure control.

compared to natural flowing wells under back-pressure. The formation below the flow line is of first importance and is governed by the same factors as a natural flowing well. The flow in the tubing, which is a means of controlling the flow differential, has, heretofore, been given much detailed discussion and is given secondary importance in this discussion.

Fig. 6 shows data obtained by actual test on a natural flowing well.[3]

An analysis of the data of Fig. 6 shows that as the flow bean opening is reduced the production rate is also reduced. The rate of decrease in production is about equal to the reduction in area of the opening through the flow bean. It can also be seen that as the flow bean size is decreased the amount of gas produced is very materially lessened up to a certain point. At this point the flow differential is such that the formation is practically re-saturated as previously discussed. After this point is reached further reduction of bean size has but little effect on the amount of gas escaping with the oil.

The lower curve of Fig. 6 is calculated from the gas and oil production curves. It clearly shows that there is a pressure at which the well can be operated to give maximum efficiency regarding the gas factor. This point may not give the best mechanical efficiency regarding the flow line, but it is the one which will allow the well to produce the greatest ultimate amount and the point at which the well should be operated regardless of flow-line efficiency.

As the formation gradually becomes depleted the pressure conditions change. This effect causes the low point of the gas factor to move to the left. Not enough data have been obtained to date to indicate the relationship between the working pressure and the rock pressure for the point of minimum gas factor. It is, however, assumed that for any particular well there is a definite relationship and that the point of minimum gas factor can be calculated at any time from the rock-pressure decline curve of the well. Work done on control and operation of gas wells shows this relationship to exist.[4]

When a well, either flowing naturally or by gas lift, is put under pressure control the production rate for best results is reduced to 60 to 80 per cent of the open flow of the well. After the differential in the formation is decreased, due to the pressure imposed, the decline rate will be far less than that which will normally occur under open flow conditions. The amount of oil not produced after first applying back-pressure, on account of the decreased rate, is soon regained by the flat decline existing after back-pressure is applied.

Fig. 7 shows the production curves of the same well from which the data of Fig. 6 were obtained. While the data obtained only cover a period of a few months it is typical of results to be obtained over long periods by pressure-control methods of operation. The curved line in the oil production curve of Fig. 7 is a normal decline for wells in the vicinity of the one referred to. It can readily be seen that after 17 days from the time back-pressure was applied the decline curves crossed.

A study of Fig. 7 shows:

Total oil produced from May 18, 1927, to Aug. 22, 1927, 327,777 barrels.

Total gas produced, 199,004 M cubic feet.

Average Total Gas Factor, 612 cubic feet.

Oil produced before applying pressure control, 53,194 barrels.

Gas produced before applying pressure control, 42,118 M cubic feet.

Average gas factor, 812 cubic feet.

Oil produced under pressure control, 274,583 barrels.

Gas produced under pressure control, 156,886 M cubic feet.

Average gas factor, 569 cubic feet.

The pressure control is responsible

[3]Personal communication from K. C. Sclater.
[4]E. O. Bennett and K. C. Sclater: Some New Aspects of the Gas Lift. Petroleum Development and Technology in 1926, 115.

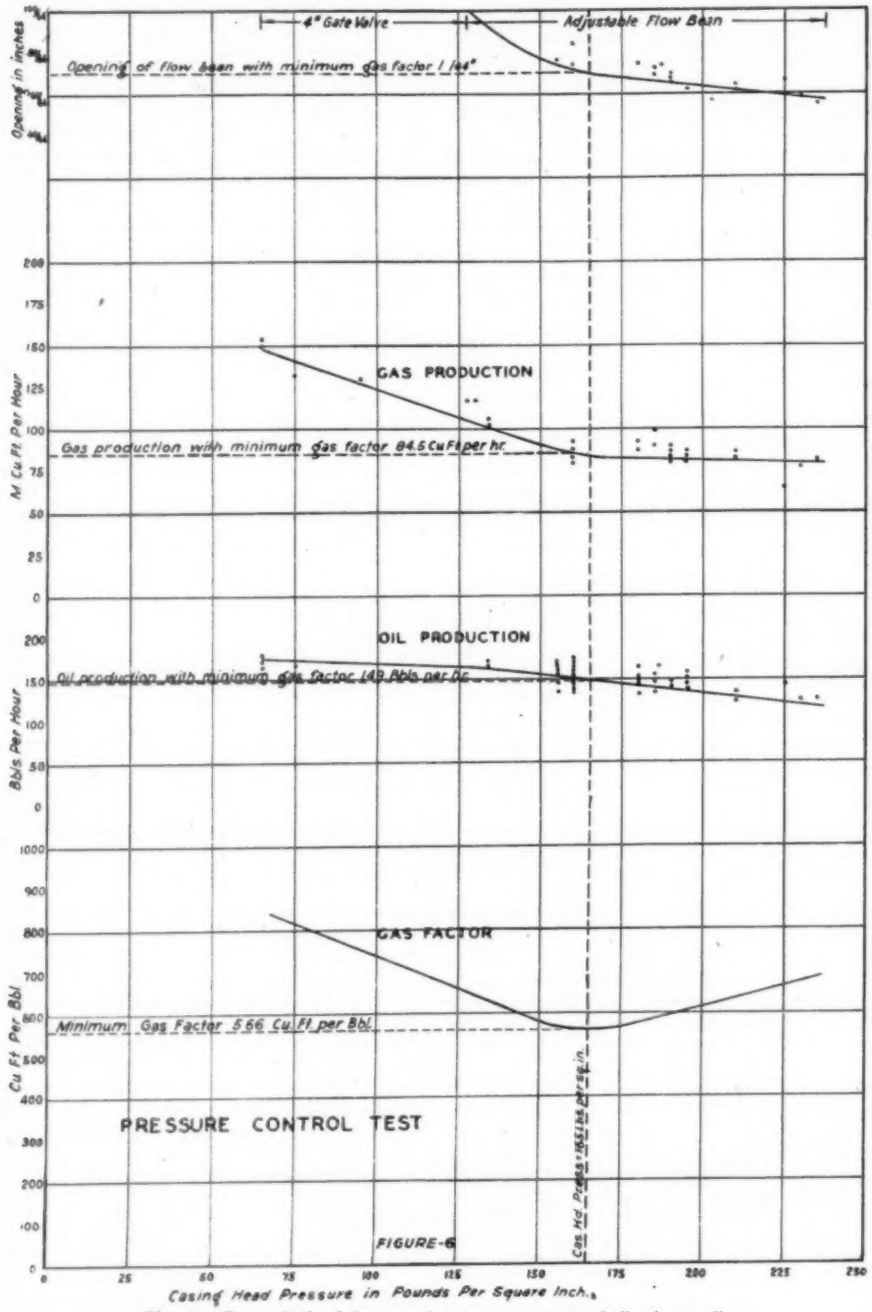
4" Gate Valve
Adjustable Flow Bean
Opening of flow bean with minimum gas factor 1/64"
Opening in inches
GAS PRODUCTION
Gas production with minimum gas factor 84.5 Cu Ft per hr.
M Cu Ft Per Hour
OIL PRODUCTION
Oil production with minimum gas factor 149 Bbls per Dy.
Bbls Per Hour
GAS FACTOR
Minimum Gas Factor 566 Cu Ft per Bbl.
Cu Ft Per Bbl.
PRESSURE CONTROL TEST
FIGURE-6
Csg Hd Press 165 lbs per sq in.
Casing Head Pressure in Pounds Per Square Inch.

Fig. 6. Data obtained by actual test on a natural flowing well.

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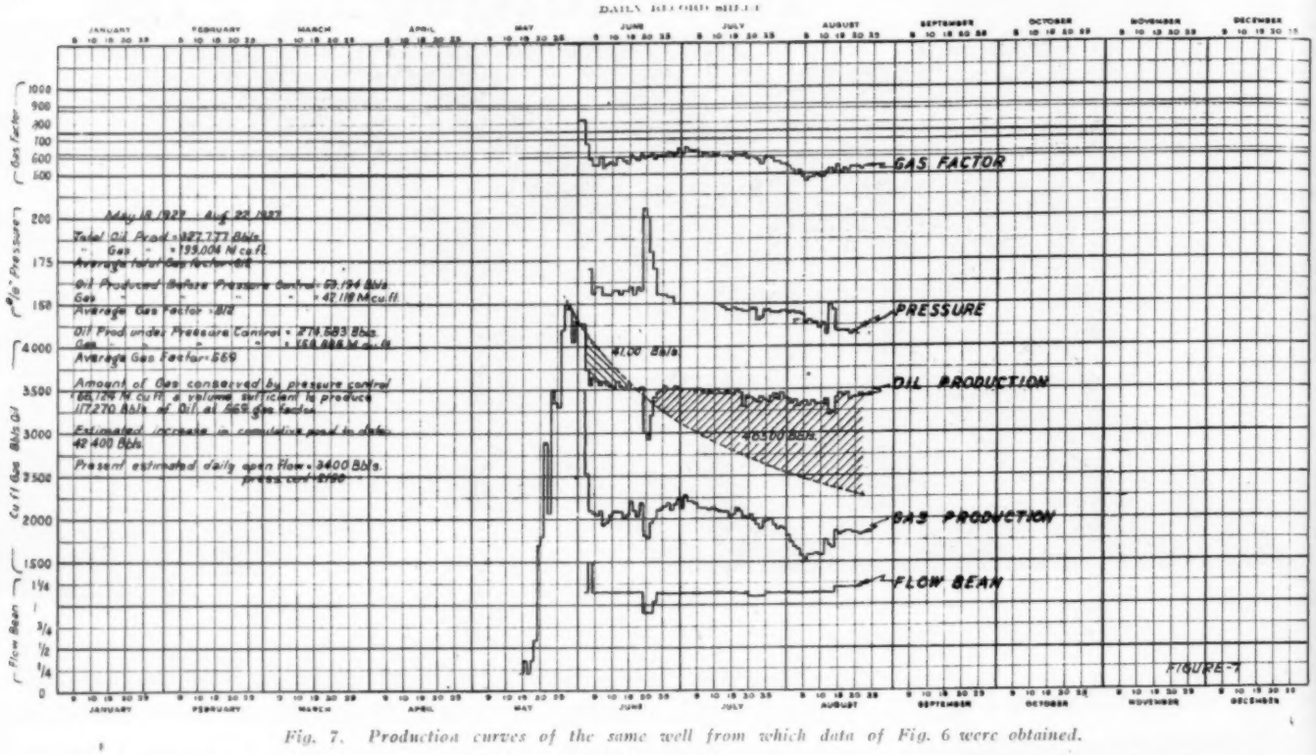


Fig. 7. Production curves of the same well from which data of Fig. 6 were obtained.

for the reduction in gas factor from 812 to 569 cubic feet or 243 cubic feet for each barrel produced. At this rate the total amount of gas conserved by pressure control is 66,724 M cubic feet. At 569 cubic feet per barrel this amount of gas is sufficient to produce 117,290 barrels. The cost of making this change in gas factor has been only the time required for making the study.

The total estimated increase in cumulative production to date is 42,400 barrels. The present daily open flow rate of the well is 3400 barrels. The pressure control rate is 2150 barrels or 63.2 per cent of the open flow rate.

The gas lift, properly applied and controlled, will increase the ultimate production of a well. If not properly handled, it will decrease the ultimate production. Proper handling consists principally, of the degree of skill practiced in maintaining back-pressure control on the formation.

Fig. 8 shows the production and gas-decline curves of a gas-lift well. The data for these curves were started the day the well was placed on the gas lift. This well would not flow naturally when drilled in but was swabbed

MASON - 3

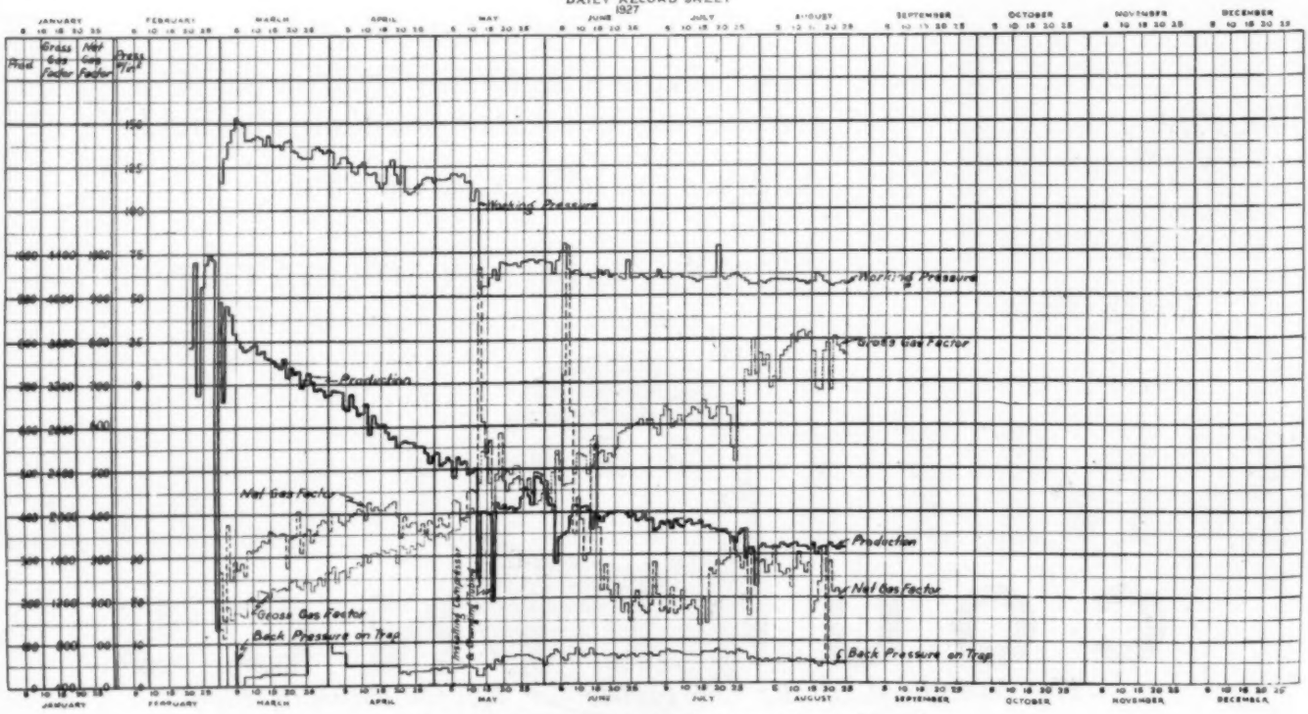
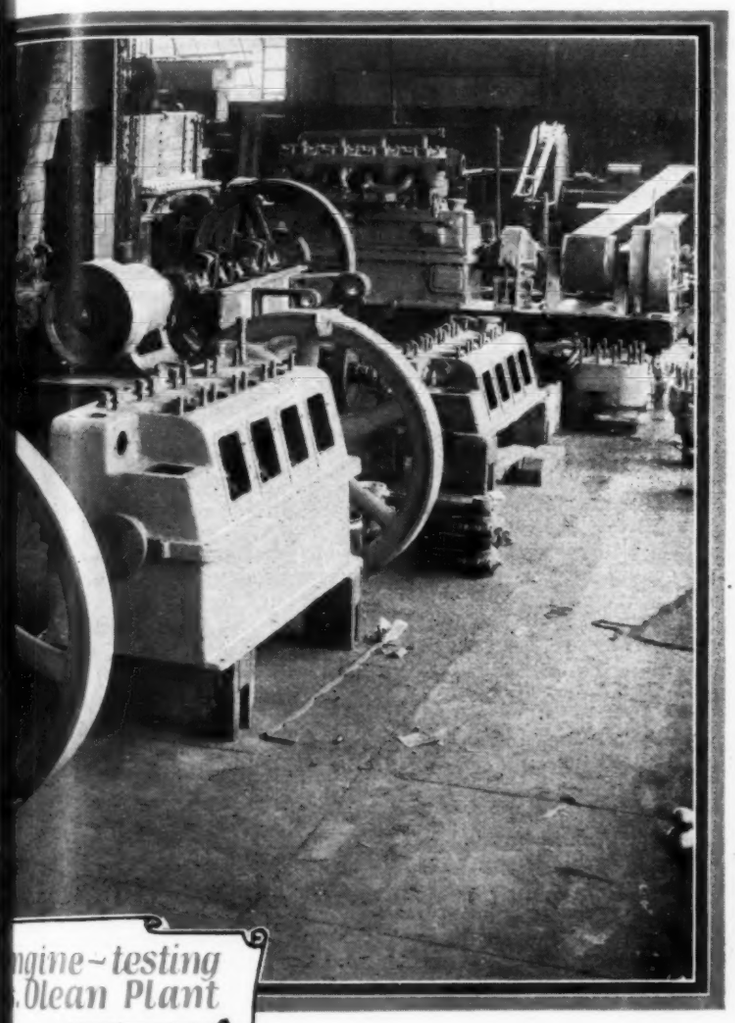
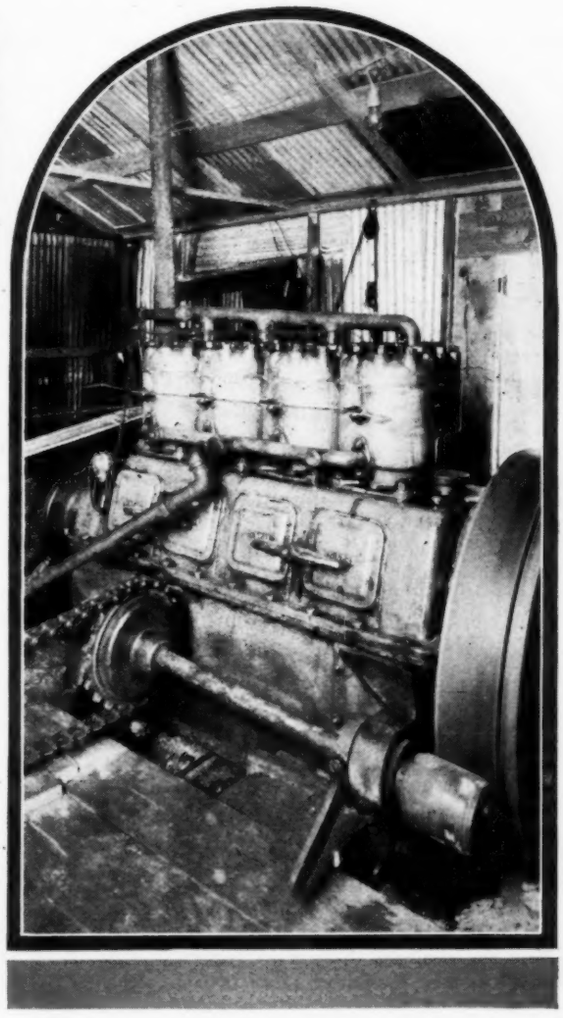


Fig 8. Production and gas-decline curves of a gas-lift well





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through the 8¼-inch casing at the rate of 1700 barrels per day. Swabbing the well caused the collapse of the bull wheel shaft and other difficulties accompanying this method of production which made it uneconomical. The lowest possible back-pressure was imposed on the well while is was being swabbed.

After the well was placed on the gas lift it started to decline regularly at the rate of about 6.5 barrels per day, with an increasing natural gas factor and a declining working pressure. Although the decline on the gas lift was far less than that under natural flowing conditions it was considered too great. The estimated natural flow decline curve is shown below the gas-lift curve. After the well had produced for about 2½ months the tubing pattern was changed which permitted a reduction in working pressure from 124 to 60 lbs. This large reduction in pressure was made possible by circulating more gas per barrel than had been previously used. This can be seen by studying the gross gas-factor curve. At the same time the pressure was reduced in the flow line the back-pressure on the formation was reduced.

Based on mechanical efficiency in the flow line as is general practice the efficiency of this well looks exceedingly poor, the output gas factor being about 3500 cubic feet per barrel. In making the changes the net or natural gas factor was decreased from 500 to 175 cubic feet per barrel. In other words, the change permitted the well to produce with about one-third as much energy as had previously been used from the formation. It will be noted that while the production rate dropped after the change was made, its rate of decline became much less and in 12 days after the change was made the curve crossed the former decline curve and remained practically constant. Extreme irregularities in the curves are due to engine and compressor troubles.

The only expense involved in handling a well in this manner as compared to getting maximum efficiency from the flow line is the cost of compressing the gas circulated. When the production under "flow line efficiency" and "ultimate efficiency" is compared it can be seen that this added expense is very small compared to the increased returns from production.

In this particular well there was no increased cost on account of increased amount of gas circulated. When the tubing or flow line was changed to permit the larger volume the working pressures changed to the point where single instead of two-stage compression could be used. This permitted handling a larger volume with the same horsepower requirements, the cost being proportional to the horsepower used. In designing a gas-lift installation it is advisable to choose a type of machinery that can readily be changed from two-stage to single stage when required.

By maintaining some back pressure on the well head the efficiency of the whole cycle is increased. Maintaining 15 pounds on the compressor intake doubles its capacity The increased capacity permits lifting the oil with higher back-pressure than could otherwise be used and with the well head back-pressure permits the total differential pressure from the formation to the trap to be controlled. The working differential in the well referred to is but 38 pounds from the sand to the trap. The depth of the well is 2500 feet and the size of the flow line is 5-3/16-inches. This is considerably larger than the flow lines used in general practice for wells producing but 300 barrels per day.

By proper handling of the gas in a gas-lift cycle the gravity of the oil may be raised and the amount lost by outage vapors decreased. On the well referred to the discharge from the trap is recycled through the compressor. The wet vapors or lighter hydrocarbons that were formerly escaping from the trap amounted to 5 per cent of the total production; when returned through the closed system they increased the production 20 barrels and the gravity 3¾ degrees.

The gas lift can be very effectively used to increase the ultimate production of a field in which bottom water encroachment is encountered. Pressure and flow conditions may be so regulated that back-pressures on the formation sufficient to hold down bottom water coming can be maintained allowing lateral drainage of oil above the water plane. This method of operation has been in successful use for the past year in the Panhandle. A well in this district, that made 100 per cent water in December, 1926, has averaged 590 barrels of oil per day since that time.[5] The gas lift has also made economical recovery from wells producing as much as 90 per cent water. Some wells in this class produce as much as 2500 barrels of fluid with but 250 barrels of oil.

Wells operating on the gas lift seldom need cleaning out, due to the steady flow conditions that prevail. This fact has been instrumental in the development of a new and successful clean-out method, which involves the fundamental principles of the gas lift.

Conclusions

1. Where pressure conditions are suitable for using the gas lift the flow rate of wells thus producing can generally be increased over the rate which can be maintained by other means.
2. When the gas lift is used to increase the daily rate of a well, instead of being used as a means of back-pressure control, the ultimate production of a well will generally be decreased.
3. If the gas lift is used as a means of controlling the pressure on the formation the daily rate will be decreased but the well's utlimate production will be increased.
4. The gas lift is effective in increasingthe ultimate production of a field under hydrostatic pressure where water has encroached into the oil-bearing formation.
5. Where offset wells are producing on the gas lift the best results and greatests ultimate recovery can be made when they are operated under similar conditions. An agreement as to pressure and rates should be reached by the operators. Trying to beat the offset generally works to the disadvantage of each.
6. To obtain the greatest ultimate yield from a well complete knowledge of pressures and volumes must be obtained. Proper equipment and supervision is the only way in which this can be done.

Principles of Air Lift as Applied to Oil Production

(*Continued from page* 46)

oil ratio as measured in volumes can be used when limited to conditions otherwise comparable, which is in measuring efficiency of methods of operation on the same well at about the same time; that is, if in operating the well the back pressure is changed, the difference in efficiency can be measured by the volume of gas alone, for within the short time between the changes in operation there will ordinarily be no important change within the sand body and in the well. But in making such comparative tests each method of operation should be continued long enough that there be complete readjustments of pressure and other conditions underground.

Where, however, the gas-oil ratio is used to compare the efficiency of a process as applied to two different fields, two different properties, or even two different wells, it does not take into account the diffeernces in the energy represented by a given volume of gas, so that under such circumstance, it is essential that the pressure factor be taken into account and that the relative efficiencies be represented on a true comparative basis; that is, in foot

[5] E. O. Bennett and K. C. Sclater: Some New Aspects of the Gas Lift. Petroleum Development and Technology in 1926, 115.

pounds of work, but in comparing the efficiencies in recovery between different wells, pools, or properties, it must be borne in mind that the efficiency of recovery is mostly determined by underground conditions, and, in measuring the efficiency of recovery at a well, one measures the frictional resistance and slippage in the forcing of the oil through the sand to the well primarily, and secondarily the effect of the manner of operation of the well upon these recovery factors.

There is also much confusion among both engineers and operators as to the function of the gas-oil ratio in that the opinion seems to be prevalent that the gas-oil ratio is a cause of efficiency, whereas, it is only a measure of efficiency, just like the thermometer is a measure of a change in temperature but does not cause a change in temperature. The value of the gas-oil ratio is that it provides a simple and practicably usable means of measuring the sum of the results from the complex relation of many factors underground and in the well, which include the pressure, nature, and volume of the gas, the distance the gas and oil have to travel to the hole, the resistance of movement of the oil through the sand by reason of friction, viscosity, adhesiveness to the sand grains, and other factors which consume or waste energy.

Inasmuch as the gas is a means for forcing the oil out of the sand, we are interested in so applying the means as to get a maximum quantity of useful work from it, the useful work being represented by the oil delivered to the tanks. In the sense as outlined here, the use of the gas-oil ratio, which more correctly could be termed the gas-pressure-oil-ratio, is as fundamentally correct as a similar use in measuring the efficiency of the gas lift alone or in a steam engine, gas engine, or any other mechanical contrivance deriving its energy from an expanding gas. We believe the question as to its utility as a measure of oil efficiency has come about through a misunderstanding of its fundamental principles and the resulting misapplication and confusion as to its utility. Until the engineers clearly understand and correctly apply these principles the same confusion will exist.

In order to point out the fallacy of basing oil recovery efficiency on gas-oil ratios only, we will work out two specific problems, which problems represent approximately the conditions existing in two pools with which we are familiar, taking one well from each pool, which hereinafter will be designated as A and B.

Well A is 4000 feet deep and has 1200 pounds absolute rock pressure and is flowing with 200 pounds absolute pressure at the sand face and 15 pounds absolute pressure at the well head. It is producing 3000 barrels of oil per day with 1,500,000 cubic feet of gas of a gravity of 1.

Well B is 2000 feet deep and has 325 pounds absolute rock pressure in the sand, and is flowing with 122 pounds absolute pressure at the sand face and 33 pounds absolute back pressure at the well head. It is producing 600 barrels of oil with 600,000 cubic feet of gas per day of 1 gravity.

In case A, there is required 500 feet of gas to produce a barrel of oil from the sand, and

In case B, there is required 1000 feet of gas to produce a barrel of oil from the sand.

Assuming adiabatic work by the gas, the number of foot pounds required to expel the oil from the sand in

Case A is 5,560,000,000
and Case B is 1,110,000,000

and the foot pounds per barrel in

Case A is 1,855,000
and Case B is 1,855,000

That is, the actual energy used to expel one barrel of oil from the sand is the same in A as it is in B, even though twice the number of cubic feet of gas per barrel of oil was used in B.

Still assuming adiabatic work of the gas, the foot pounds of work in the gas in expanding from the sand to the surface in

Case A is 2,680,000
and Case B is 2,680,000

but this quantity of gas or energy was not sufficient to keep the wells flowing steadily under the above conditions, and it was in each case necessary to supply additional air.

In case A, there was supplied an additional 1,500,000 feet per day, making a total of 3,000,000 feet per day.

In case B, there was supplied an additional 600,000 cubic feet of gas per day, making a total of 1,200,000 cubic feet per day.

Therefore, the foot pounds of work used in lifting the oil from

Case A is 16,000,000,000
and Case B is 3,200,000,000

per barrel in

Case A is 5,360,000
and Case B is 5,360,000

and the efficiency of lifting the oil only, by the gas assuming isothermal expansion, and 86 specific gravity of the oil in

Case A is 22.3 %
and Case B is 11.15%

Estimating Compressor Capacity

The following problem is given to show what size compressor and engine would be required to furnish the additional gas necessary to flow the two representative wells in the previous example.

Assuming adiabatic compression, and allowing 30 per cent for loss in friction and slippage in the compressor end and 85 per cent mechanical efficiency for the machine, the horsepower of the gas engine to pull the compressor, which would deliver the necessary air would be in

Case A 335 H.P.
and Case B 112 H.P.

and the number of feet of gas per day required as fuel to operate such an engine assuming 14 per cent thermal efficiency and a gas of 1200 BTU per cubic foot, would be in

Case A 129,000 cu. ft. per day
and Case B 41,000 cu. ft. per day

For example:

Suppose it were necessary to furnish all the energy necessary or used by these two wells in the expulsion of the oil from the sand, and raising it to the surface, in Case A we would have to install a 1214 H.P. unit.

and in Case B we would have to install a 287 H.P. unit.

or, in other words, the actual horsepower expended in producing a barrel of oil from

Case A is .405
and Case B is .478

and in this case the overall efficiency, or the relation between the amount of energy in the fuel necessary to run such a compressor as compared to the actual energy delivered in expelling and raising the oil in

Case A would be about 2%
and Case B would be about .8%

It has been necessary to divert from the subject in hand in order to prepare the ground for a discussion of the relation of the air-lift to efficiency in oil recovery. There have been some claims of mysterious effects of the air-lift on recovery as measured by gas-oil ratios and on the other hand, there have been claims that the air-lift has been detrimental as measured by the same criteria.

So far as the writers can see the air-lift has two effects on the efficiency of oil recovery: one, by reason of changes of back pressure against the sand and the other by reason of its effect upon the condition at the bottom of the hole. The last factor is comparatively of less importance, and, therefore, will simply be covered by stating that the gas lift tends to remove the sand, mud, and other matter from the hole, thus keeping the hole clean. However, it also can be applied as to paraffin up a sand.

It seems doubtful whether the gas-lift has any important effect on recovery other than the back pressure applied against the face of the sand; therefore, the discussion of the air lift upon efficiency of oil recovery comes back to the same controversal question as to the use and utility of the back pressures. Without presenting evidence or analytical reasons for their opinions the writers merely wish to state that they believe the back pressure will be beneficial or not wholly in accordance with the degree of pressure applied, and the manner of applying it, and in relation to the location conditions. When the junior author discussed this subject in bulletin No. 148 of the Bureau of Mines, he called attention to the fact that too high a back pressure would be detrimental but, on the other hand, there was much evidence that at some point there would be a back pressure for each condition which would be beneficial just as there has been shown to be an optimum submergence

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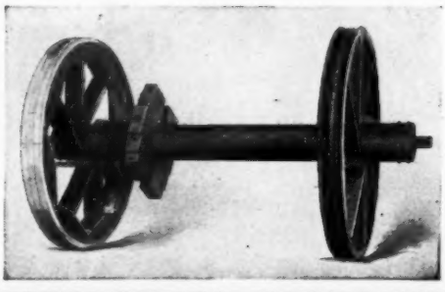

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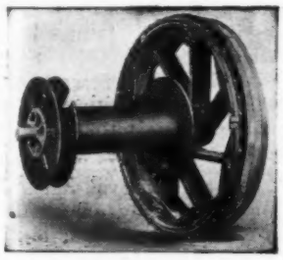

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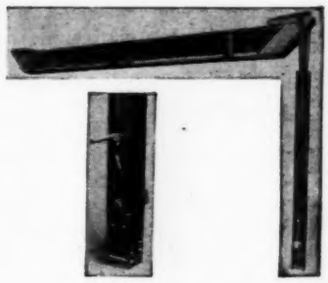


EQUIPMENT

DALLAS, TEXAS HOUSTON, TEXAS WICHITA FALLS, TEXAS BORGER, TEXAS PARKERSBURG, W. VA.
CASPER, WYO. SHREVEPORT, LA. EL DORADO, KAN. EL DORADO, ARK.

Say you saw it in The OIL WEEKLY

for the air-lift with relation to the other concurrent conditions.

A high back pressure prohibits the full expansion of gas and thus lessens the amount of energy delivered by it. On the other hand, if the gas is allowed to expand to its maximum extent, the additional work delivered will be largely consumed in greater velocity and, therefore, greater friction, so that additional useful work theoretically available will be small. Furthermore, there is good reason to believe that the higher velocities created will result in greater slippage of the gas through the sand and it has been shown by Henry L. Doherty that the taking the gas out of solution from the oil will also have an important and seemingly detrimental effect on the physical properties of the oil.

These lines of evidence are reasoned out by a careful consideration of the results from applying back pressure both under artificial pressure and under natural pressure. The seemingly irreconciable results reported by varoius observers of back pressures both when used with air-lifts and elsewhere can be explained by the fact that account must be taken of the limited range in which back pressure can be advantageously used, which if either less or more, will be harmful.

If the writers are correct in their conclusions the effect of the air-lift upon oil recovery is to be measured by the back pressure created by it and the air-lift should be designed and operated at a pressure to conform with the back pressure giving the best results in oil recovery.

These considerations, however, are limited by the practical ones of the competitive conditions at the well and therefore the necessity for getting the highest daily production. Not until a great deal more observational data has been collected and analyzed can it be known how to work out the use of back pressures and how to design the air-lift so as to get the back pressures desired, and at the same time have an efficient air-lift within the limits imposed by the size of the casing and other economic and practical conditions.

It may at first thought seem that the air-lift, which in a deep well may be imposing several hundred pounds of pressure on the well, would create a back pressure instead of lessening the back pressure, but, actually, a naturally flowing well may have a greater back pressure on the sand than is necessary to lift the oil by the air-lift and this is even true with a pumping well. If for any reason the oil coming into the well is not removed as fast as it enters, it heads up in a well and exerts a big back pressure, as has been shown in discussing figure 1. This will take place if the pump has not sufficient capacity or in a flowing well if the pressure and volume of the gas does not supply enough energy to lift the oil rapidly. Under these conditions the air lift by removing the accumulated column of oil will actually reduce the pressure on the sand.

Need for Better Information

Tests made on the deliveries of air compressors have disclosed that assumptions as to their delivery, horsepower, and efficiency founded upon manufacturers claims and ratings are very unreliable and conclusions based upon such data should not be accepted. As operated in the field, a compressor is not of the same efficiency as when tested on the floor of the factory. Analogous errors have been noted in other observational data, and until the information gathered in the field is more complete and dependable progress in air-lift engineering will not be satisfactory.

Problems and Their Solution in the Appalachian Field

By FRANK BREWSTER

MANY operators are of the opinion that paraffining is confined to the tubing and pumping equipment, but it is evident, states Frank M. Brewster, "the most serious damage occurs on the face of the sand and a short distance back into the pores." The paper was called "Handling Congealing Oil and Paraffin Problems and Their Solution in the Appalachian fields."

Principal causes of paraffining, according to the author, can be classified as follows,

(1) The chilling incident to the sudden reduction of pressure and expansion of gas in the wells and in the producing sands close to the wells.

(2) The diminished solubility of the paraffin at the lowered pressures generally prevailing in the wells.

(3) The churning action of the pumps and sucker rods which tends to accentuate the emulsification of water, oil and silt.

(4) The evaporating and drying action of natural gas.

(5) The alternate wetting and drying of the productive sand exposed in a well where the fluid level is repeatedly lowered from the top to the bottom of the sand by pumping.

(6) Leakage of certain kinds of water into wells, especially water carrying mechanically suspended silt or waters that carry dissolved salts which act chemically with the salts dissolved in other waters in the wells so as to form silty precipitates.

Paraffining is an accumulating evil that may plug off the pores in the sand long before the well is exhausted by present production methods.

Two methods of preventing paraffin accumulation in wells prevails in the Appalachian fields: One is to keep the sand covered at all times with oil; the other is to hold a back-pressure on the sand by partially cutting off the flow of gas from the well.

Methods of removing paraffin include cleaning out, shooting, reaming the sand, the use of solvents such as gasoline, benzol, etc., heating and melting by steam, hot water, hot solvents and chemicals and by burning with chemicals or combustible mixtures introduced and ignited opposite the face of the sand,

In his conslusion, the author writes: "Present methods of removing paraffin from the face of the sand and out of the pores are not entirely satisfactory. The cost is very high and the beneficial results are usually short-lived, as generally within a few months production has declined to the same level preceding cleaning.

"The use of chemicals as a whole is unsatisfactory. The heat generated is insufficient to cause an appreciable amount of paraffin to be melted, and if larger quantities of chemicals are used the cost becomes prohibitive.

"Solvents are better than chemicals for removing paraffin, but to get satisfactory results it generally is necessary to heat and circulate the solvent for several hours. Also in deep wells and large shot holes, the quantity of solvent necessary for satisfactory results makes the cost a considerable item.

"In most cases the removal of paraffin by burning or hot solvents has become the more satisfactory. For cleaning tubing, casing and pumping equipment, mechanical means are by far the better method."

Ventura Extension

Ventura, Calif.—Prospects for the extension of the producing limits of the Ventura field are considered bright, as the result of the discovery of a few feet of oil sand in the Associated Oil Company's Dabney-Lloyd 1, which is drilling below 6450 feet. Several feet of sand was cored, indicating that the well still has a chance of production, despite its depth and absence of showings below 5000 feet.

Gas Factor As Measure of Oil Production Efficiency

(*Continued from page 42*)

western and Mid-Continent oil fields, is wasteful of gas energy and results in a lower ultimate recovery of oil than would be possible by wider spacing. When wells are drilled within oil-drainage radius of each other, the prevailing gas factor will be generally higher than in areas in which a proper interval between wells is maintained. The writer believes that additional proof of this theory may be found by a close scrutiny of production data in fields in which variable spacing of wells in different comparable areas has been practiced.

Influence of the Production Method on the Gas Factor

There is no doubt but that the production method employed, the degree of well control and general production technique of the operator have an important influence on the gas factor and on gas-energy consumption. A naturally flowing well is inefficient in this respect, and leads to higher-than-normal gas factors, because the formational gas is required not only to drive the oil into the well, but also to lift it to the surface. In the case of a 3000 foot well, about 930,000 foot-pounds of work must be done in merely lifting each barrel of oil to the surface after it enters the well. Assuming 100 per cent efficiency, a well producing, say, 1000 barrels per day from this depth, must thus continually expend 19.57 H. P. It is known, however, that due to gas slippage and other inefficiencies, flowing wells have a very low efficiency, seldom exceeding 20 per cent, and often much lower. Assuming 20 per cent efficiency, the actual power consumption is nearly 100 H. P. The formational gas must furnish this energy in naturally flowing wells, and hence their gas factors are higher than when other methods of lifting the oil are employed.

Gas-lift wells can be considerably more efficient in so far as consumption of formational gas energy is concerned, for here external energy in the form of gas compressed and forced down into the well, supplies the greater part of the energy necessary to lift the oil. It is to be noted, however, that even in a gas-lift well, the formational gas must provide a part of the energy necessary to lift the oil to the surface. If the volume of gas forced down from the surface be measured and subtracted from the total volume of gas reaching the surface, the formational gas factor —in which we are here primarily interested—will be found materially lower than in naturally flowing wells producing under comparable conditions.

For maximum efficiency in any type of flowing well, it is important that the well be tubed to the proper depth. Tubing depth not only influences the lift efficiency, but may, under favorable circumstances have a favorable effect in reducing gas channeling in the sands about the well.

A pumping well may operate more efficiently than any other insofar as consumption of natural gas energy is concerned, for here the formational gas is called upon to supply only enough energy to force the oil into the well, and mechanical power employed in lifting the oil to the surface, is supplied entirely from external sources. If flow of gas between the well tubing and the enclosing casing is prevented, and the pump is placed at a suitable level in the well to prevent channeling of gas toward the well in the reservoir sand, a pumping well may operate with a lower gas factor than a well operated by any other means.

In some fields, edge-water pressure aids materially in forcing the oil into the wells, the oil being produced with comparatively little formational gas. It should be recognized in such cases that we are dealing with a radically different type of expulsive force and that the gas factors obtained in wells producing by this means, are in no sense comparable with those obtained in other fileds where production is secured entirely by the expulsive force of expanding natural gas.

Influence of "Economic Life" of Oil Property in Determining the Gas-Factor Giving Most Economic Recovery Rate

While the ultimate oil recovery will be increased through application of the proper degree of back-pressure to producing oil wells, the time within which production is secured is ordinarily extended over a longer period than when no back-pressure is used; and it will perhaps happen that the critical back-pressure giving maximum ultimate oil recovery, will result in unduly prolongjng the period of exploitation. Under the highly competitive organization of the present-day oil-producing industry, an operator may find it expedient, or more profitable, to accept a smaller total yield from his property in a short period of time, than to extend operations over a longer period for a greater ultimate yield.

The "economic life" of an oil-producing property[6] or the total lfie-period as determined by the rate of production yielding maximum profit—a conception which involves consideration of the cost of production, the selling price of oil, the interest rate demanded on capital and many other economic as well as physical factors—is inextricably interwoven with the whole subject of gas conservation. From the standpoint of the producer, the rate of production, which is determined by the back-pressure employed and the resulting gas factor, must be an economic one: that which will result in maximum ultimate profit.

The gas factor which results in maximum ultimate oil yield will ordinarily not be the one which is productive of greatest ultimate profit to the producer. The oil conservationists and industrialists must therefore seek a middle ground between these two viewpoints in determining what constitutes a reasonable recovery efficiency that will be in accord with the public interest in a rapidly diminishing national resource, and yet fair to the producer from the economic standpoint. Prices must control in the final analysis: higher price will compel more efficiency recovery, while a depressed price structure will encourage production inefficency.

Conclusions

The objective of this paper is to emphasize the fact that the gas-oil ratio or gas factor of a producing oil well is not a reliable index of production efficiency unless the influence of a variety of other contributing factors is taken into account. The several variables which have a bearing on the magnitude of the gas factor are reviewed and their influence is explained.

The discussion and data offered apparently justify the following conclusions:

1. The volume of gas produced with a unit volume of oil is not in itself a measure of production efficiency unless the pressure from which the gas expanded to its measured volume is taken into account. The gas factor is of interest only as a measure of energy consumed, and has no significance until considered in relation to the initial pressure at which it existed within the reservoir sand. Release of pressure within the reservoir sand, occasioned by production of oil and gas, results normally in a gradual increase in the gas factor. It is suggested that a better basis of comparison for oil well

[6]For a more extended discussion of the factors controlling the economic life of oil-producing properties, see an article by the writer in Oil-Field Engineering (Los Angeles), issue of November, 1926, pp. 49-52, 86-87.

production efficiencies would be found in the product of the gas factor by the number of times the volume of the gas has increased in expanding from the formation pressure to that at which it is measured.

2. The flow resistance offered by the reservoir sand to passage of oil through it will primarily determine the energy necessary to accomplish its transaltion, and thus will influence to an important degree, the magnitude of the gas factor. Flow resistance is a function of the sand permeability, which in turn depends upon the size of sand pores, texture of the mineral grain surfaces, and viscosity and surface tension of the oil. The rate of flow and distance traversed are also factors of importance in determining the sand resistance.

3. Release of gas from solution in the oil, resulting in the formation of minute gas bubbles which remain occluded in the oil within the sand pores has an important influence in increasing the sand resistance to flow. For this reason the energy necessary to cause flow, and the gas factor, are increased as the pressure declines and the gas is released from solution in the oil. The resistance to flow is further increased as the occluded gas bubbles grow in size with continued release of pressure.

4 Advancing age of the wells, with attendant growth in the extent of oil-drained channels within the reservoir sand, promotes channeling of the gas from points remote from the wells, without comparable movement of the oil. Such oil as is produced is therefore accompanied by a greater quantity of gas than during the early period of development when gas channeling is not a factor of such great importance.

5. Close spacing of wells also promotes channeling of gas within a resulting high gas factor. Rapidity of production, which results from crowding of wells leads to high gas-energy consumption and a higher gas factor than would be possible with properly spaced wells. Each additional well drilled within oil-drainage radius of other wells is a gas liability and leads to a reduction in ultimate oil recovery.

6. The method of production and technic of well control have an important influence in determining the gas factor, occasioned chiefly by the extent to which the formational gas is relieved of the necessity of lifting the oil to the surface, and the precautions taken to prevent channeling of the gas in the vicinity of the wells. In this regard, free-flowing wells are least efficient, gas-lift wells are more efficient and pumping wells most efficient. It is important that the well be tubed to a suitable depth, irrespective of the method of production employed.

7. Application of back-pressure to producing wells, provides a means of reducing the gas factor by reducing the rate of flow of fluids in the reservoir sand, and minimizing growth of the occluded gas bubbles wthin the oil as they approach the wells. For any given set of conditions, there is a certain back pressure which if maintained, will result in maximum ultmate recovery of oil. Either higher or lower back-pressure will result in decrease in the ultimate recovery. This most efficient back pressure is not constant throughout the life of the well, but decreases as the formation pressure and rate of production decreases.

8. The most efficient back pressure and gas-factor from the standpoint of ultimate recovery, are not usually those which are productive of maximum ultimate profit to the producer. The "economic gas factor" is one which must be arrived at by a proper balancing of considerations which determine the financial profit to the producer with considerations of conservation of oil resources in the public interest. The selling price of petroleum will determine how far the producer may go in meeting the conservation issue.

9. Efficiency in the use of gas energy in oil production depends primarily on proper spacing of wells, timeliness of development, maintenance of a suitable rate of production and the use of production methods which will utilize as large a part of the expulsive energy of the gas as may be possible, in forcing the oil through the reservoir sands into the wells.

Other papers which were presented before the Petroleum Division of the American Institute of Mining and Metellurgical Engineers at Fort Worth and are digested in this issue of The Oil Weekly and which will be printed in full in subsequent issues:

Handling Re-circulated Gas..... R. D. Gibbs and C. C. Taylor
Air Gas Lift Practice in California .....A. C. Rubel
Mechanical Installations For Air-Gas Lift in Texas Other Than the Gulf Coast .....E. V. Foran
Oklahoma and Kansas Other Than Seminole .....R. W. Bond
Seminole ..... C. R. Swartz
Problems and Their Solution at Amarillo ..... W. V. Vieiti

Fort Worth Engineers Organize Division of A. I. M. E; Monthly Meetings Planned

Fort Worth.—At the recent meeting of the Petroleum Division of the A. I. M. E., held here, a Fort Worth Division of the Institute was organized, to include the states of Texas, Louisiana, and Arkansas.

Officials elected were: E. O. Bennett, chairman; C. P. Watson, vice-chairman; A. Behnke, secretary; and David Donoghue, treasurer.

Mr. Bennett is chief petroleum engineer for the Marland Oil Company; Mr. Watson heads the Federal Royalties Company; Mr. Behnke is assistant superintendent of production for the Amerada Petroleum Corporation, and Mr. Donoghue is chief geologist and head of the land department for the Texas Pacific Coal and Oil Company.

The purpose of the Fort Worth division is to sponsor a monthly meeting at which a paper on some subject pertinent to oil production engineering will be read and discussed. A meeting will be called within the next few days to complete plans and then the regular monthly meetings will be started.

Those in charge of the division ask specifically that any one interested in the meetings feel free to attend them and attendance is not confined to membership in the division. It is hoped that widespread interest will be shown.

Although the division headquarters will be in Fort Worth, the organization embraces all Texas, Arkansas, and Louisiana.

Additional information can be had from E. O. Bennett, Marland Oil Company, W. T. Waggoner Building, Fort Worth Texas.

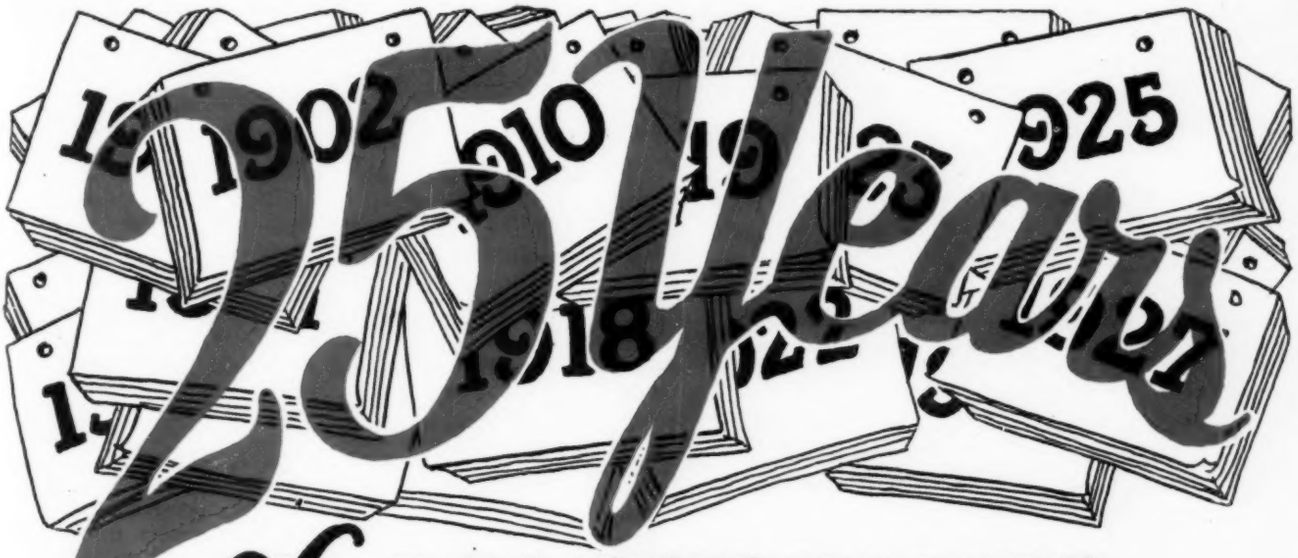
Texas Division Meets at Fort Worth Nov. 11

Fort Worth.—J. D. Collett, president of the Texas Division of the Mid-Continent Oil & Gas Association, has announced that the association will meet November 11, Armistice Day.

In the morning the annual business session will be held at the Texas Hotel. At that time officers and members of the executive committee will be elected for the coming year.

In the evening a dinner will be held at the River Crest Country Club.

The afternoon will be given over to play when the Wildcats will compete for the various cups offered.



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(*Continued from page 36*)

casing as a flow string. After unsuccessful efforts to flow through this, a 2½-inch string was run inside the 5 3/16. Gas was forced down the 2½-inch tubing and the oil produced between the 2½- inch and the 5 3/16-inch. The result was a steady flow of 1085 barrels daily with a gross gas-oil ratio of 905 cubic feet, at an input pressure of 195 pounds.

With this equipment the well was flowed for three months when the daily output dropped below 500 barrels, and the input pressure went down to 124 pounds. The lifting gas-oil ratio increased to 1600 cubic feet.

At this point it was decided to make a radical change in both tubing arrangement and therefore in compressors.

The high-pressure cylinder of a two-stage tandem-driven compressor was replaced by a low-pressure cylinder and the volumetric capacity of the compressor was doubled. Both the 5 3/16 and the 2½-inch tubing were pulled and a mixed string consisting of 275 feet of three-inch tubing in the lower part, and 2226 feet of 5 3/16-inch casing as the upper part of the tubing was run in the well. Total tubing length was 2501 feet, which placed the bottom of the tubing eight feet above the top of the sand.

The well was then put on production and 2226 feet of 5-3/16-inch casing as flow it was only 60 pounds. Six pounds back-pressure was indicated on the casinghead. This low pressure against the face of the sand resulted in an increase in the effective drainage area of the well, which, in turn resulted in a decline rate much lower than before the change was made.

The increased volume of input air on single stage compression gave remarkable results in contrast to those observed before the tubing change was made, but it also presented some disadvantages, the greatest of which was the reduction of gravity of the oil from 39.5 degrees to 38 degrees A. P. I. This was due to increased gasoline losses escaping into the air.

The output air-gas mixture was then re-circulated and condensate returned to the well. This process brought the gravity of the oil to 41 degrees and an increase of 24 barrels of oil per day.

The trend of operations in Texas at this time seems to be toward those installations which are capable of lifting a barrel of oil to the surface with the lowest gross gas-oil ratio. If the gas-lift method of production is to occupy a prominent place in the production life of a well or lease, the measure of efficiency must be reduced to lifting costs per barrel in dollars and cents and the effect on ultimate production rather than the control of the gross gas-oil ratio.

The pressure exerted on the face of a producing sand may be reduced through increased aeration of the fluid mixture, provided the tubing has sufficient cross-section area to accommodate the increased flow of gas without requiring a high velocity.

Mechanical Installations for Air-Gas Lift At Seminole

By C. R. SWARTZ

LACK of free gas in the main productive horizon, high fluid levels after wells stopped flowing, and crooked holes were major factors that influenced operators to adopt gas-lift in the Seminole field, as brought out by Clifton R. Swarts.

Because of the high gravity of the oil, 41 degrees A. P. I. and its high gasoline content, and because of the desire to obtain production before offset wells became productive, quantity production was the aim of operators. Accordingly wells were flowed through the annular space.

Six and five-eighths inch casing was commonly used as a production string, with a 5-3/16-inch line set on top of the oil sand. Two and one-half-inch upset tubing was used for introducing the gas and air. Tubing was lowered within a few hundred feet of the top of the oil sand.

Starting pressures varied from 250 to 750 pounds. Flowing or rocking pressures were from 50 pounds to 700 pounds. In the use of tapered tubing, pressures as low as 50 pounds were recorded and with flow through tubing of uniform diameter pressures were as high as 700 pounds. Average working pressure was about 190 pounds.

Quantity of gas or air required per well per day varied, ranging from 400,000 to 1,200,000 feet, the average being 750,000 to 800,000 cubic feet.

On wells flowing through the casing a suitable tubing packer and support of sufficient strength to withstand starting pressures was screwed into the control head or directly onto the casing. A pressure gauge at the well head recorded the working pressure.

Oil flow lines were four-inch and six-inch directly connected to the control head or to the casing below the well head connections.

One design had the flow line welded to the casing below the derrick floor at such an angle that the flow line led directly to the trap where with a slight bend it connected with the trap. The general practice was to eliminate all right angle bends.

Plants ranged in size from the small portable units of three compressors to larger semi-permanent and permanent installations having as many as 30 compressors.

Two general plans of air and gas distribution were used: one employed the header system in conjunction with a central plant supplying a large number of wells, the other consisting of a battery of compressors directly connected to an individual well.

Effect of Gas Lift on Physical Properties of Oil

By R. R. BRANDENTHALER

IN presenting the effect of gas-lift on the physical properties of oil, R. R. Brandenthaler stated that certain fundamental results may be expected under ordinary conditions and with all types of crude oil, when gas is the prime mover of oil in producing formations. For example, the gravity of oil will decrease as the rock pressure in the producing formation declines, the change being greater in the higher gravity oils. Furthermore the character of emulsion formed is primarily dependent upon the kind of oil.

The effects of the gas-lift on the physical properties of oil are classified under the following heads: 1. Formation of emulsions; 2. Change in the gravity of oil; 3. Changes due to heat; 4. Changes due to oxidation when air is used.

A general survey of fields throughout the country indicates that the use of gas-lift irrespective of the type of oil, results in an increase in the percentage of emulsions formed and also in more refractory emulsions, a condition which is more pronounced in localities where asphaltic base oil is produced.

Tests made in the Mid-Continent have shown that the gravity of the oil has been increased when gas is used as the expellent force. With air the increase was only nominal. Higher pressures and velocities probably account for the increase in gravity. The author adds that further investigation to determine whether the increase is temporary, as he suspects, would be interesting.

A survey of the situation as to the effect of air or gas on the gravity of oil indicates that the effect differs to some extent with different types of oil. Changes in the volume of gas used also affect the gravity of the oil, larger volumes usually resulting in a gravity decrease.

Tests in Seminole gave the following results: When the gas was replaced

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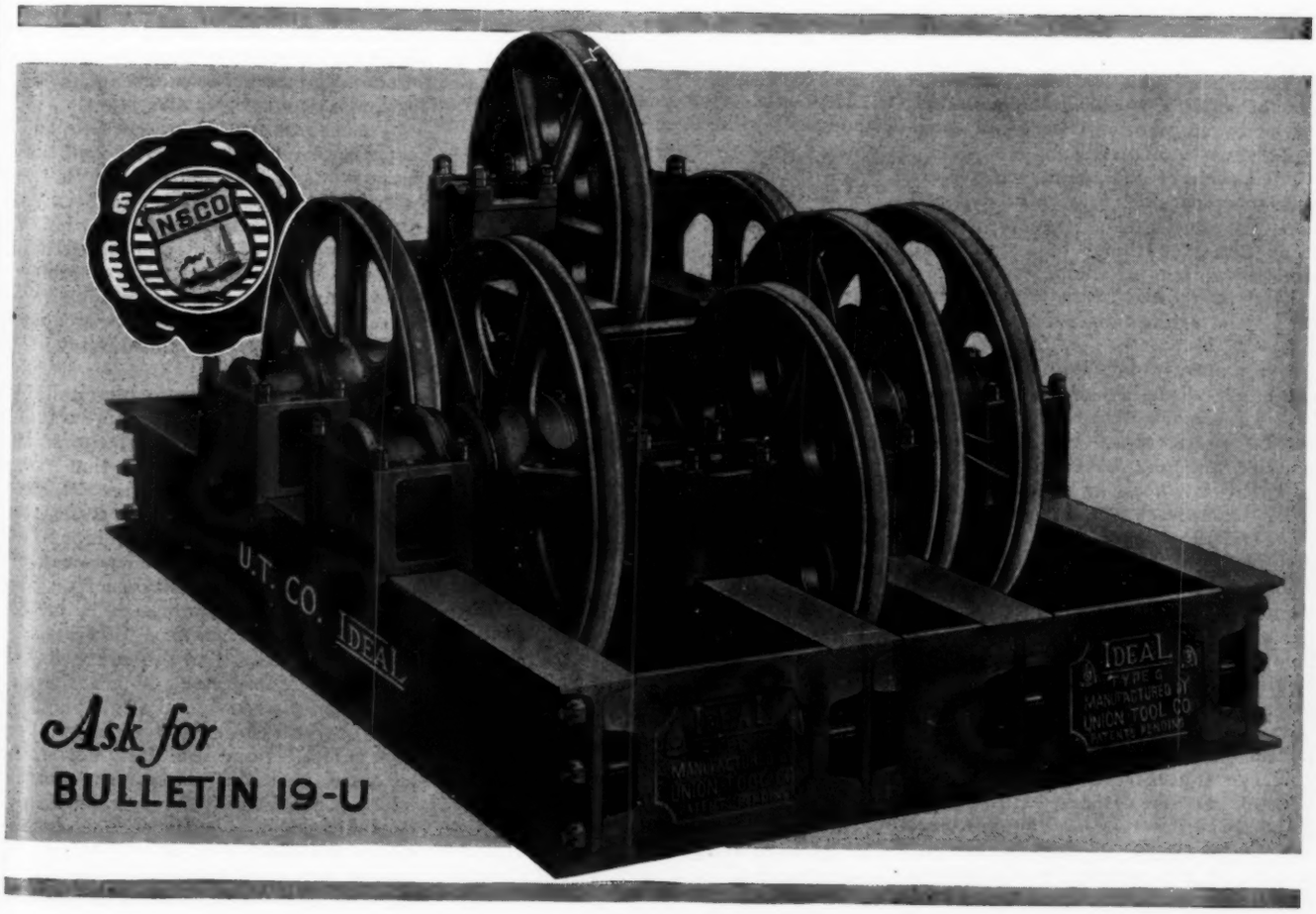

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by air, the average gravity during a period of five days was 39.5 degrees A. P. I. Thus, when air was used there was an apparent increase of 0.1 degrees A. P. I. in the gravity of the oil and an increase of 1.3 degrees A. P. I. with gas over natural flow. Another test conducted on seven wells over a period of 10 days resulted in no apparent increase with air and an average increase of 1.04 degrees A. P. I. when gas was introduced. Still another series of tests gave a decrease from the use of gas of one-tenth degree.

Preheated gas has not resulted in a permanent increase in gravity of oil produced, or in an increase in oil production in the Seminole area.

It is possible that the use of air has resulted in some oxidation of the crude oil, but information on the subject is contradictory, and the author states that he would hesitate to state that oxidation actually takes place.

Mechanical Installations for Air-Gas Lift In Oklahoma and Kansas

By R. W. BOND

MECHANICAL equipment of air-gas lifts in Oklahoma and Kansas, outside the Seminole district, was described by Reid W. Bond.

Early compressor equipment generally consists of small tandem compressors of about 250 cubic feet per minute driven by automotive type gas engines using short belt drive.

Portability of equipment was desired even after the idea of centralized stations appeared and a large proportion of operators continued to install small semi-portable type compressors.

Electric motors came rapidly into use as the prime mover for small outfits.

Many strictly portable outfits were common, consisting of an automotive type gas engine direct connected to a vertical compressor. The unit was assembled on one base and could be mounted on wheels or skids as desired.

As compressors were centralized some operators duplexed installations belt driven by slow speed gas engines. The present trend is toward the direct connected duplex driven by twin cylinder gas engines, the most common size being the 180 horsepower. Smaller semi-portable, direct connected units are still in use.

Volume regulation is accomplished by the use of one or more of several devices: Commercial flow controllers, needle valves, orifices, etc. When using these controls the common practice is to install a main header into which all the compressors discharge. Individual wells are then tied in through lines and the volume controls so installed that the controller and header may be cut out and one particular compressor, used to build up the high pressure usually necessary to start the well.

Usually an orifice meter is either incorporated in the controller or installed in conjunction with it.

All compresors discharge into a common header at a pressure slightly higher than the highest operating pressure of the wells.

As the majority of gas lift compressor stations outside of Seminole, are really booster stations, using the residue gas from the absorption type gasoline plant, the gathering system is part of the gasoline plant, and is the standard type.

In connections right angle bends have been eliminated as much as possible.

Installations of Air-Gas Lift in Gulf Coast

By L. L. BRUNDRED

CONDITIONS in the Texas Gulf Coast district, according to L. L. Brundred, have proved to be such that expenditures of large sums for more or less permanent gas-lift equipment have been considered illogical. The average operator therefore considers quickness of installation, portability to a new field and salvage value rather than cheapness of fuel and other costs of operation. The result is that by far the bulk of all installations has been steam-driven compressors.

Practically all compressors installed to date, whether steam, electric, gas or oil-driven, have had displacements ranging from 300 to 500 cubic feet per minute. Little attempt has been made to centralize control in one distributing plant serving a number of wells.

Most air wells have used the original Christmas tree hook-up with which the wells were completed.

Jets and other flow devices are prevalent.

Air-Gas Lift Practice at Seminole

(*Continued from page* 38)

duction is greatly reduced. As soon, however, as the pressure has declined and the fluid level reduced to a point where the well is acting mainly as a gas-lift, a bean causes the gas-oil ratio to increase to a high point."

The same effect of conserving gas can be secured, according to Mr. Shaw, by employing the proper size tubing through which to flow the well and the gas-oil ratio does not then increase to excessive points when the fluid level is lowered.

In handling small wells at Seminole, Mr. Shaw found that with the use of tapered tubing this method of production, from a cost standpoint, is in competition with beam pumps in many fields.

He says: "As wells become smaller in production, the pressure drops, the lift increases, and the quantity of gas required to lift a barrel of oil is greatly increased over that necessary for a large well, and this quantity increases to an abnormal extent if the lifting be done through the same eductor as when flowing a large well. A consumption of 50,000 cubic feet per barrel could easily be reached in flowing a 10-barrel well through the annular area between the 2 or 2½-inch tubing and the 6⅝-inch casing, whereas a proper size of taper-tubing would operate on 10,000 cubic feet per barrel or less, at 50-pound pressure per square inch when flowing a well of this size.

"The conditions of pressure or submergence of lift, quantity of fluid and quantity of gas accompanying the oil have a close bearing on the proper design of tapered tubing, and unless a nearly correct design is obtained it is best not to use this method of tubing, since the quantity of gas consumed per barrel of oil may become excessive and production may be considerably reduced.

"When small wells are operated by gas lift the lifting costs become a matter of great importance. If the small electric-driven compressor that was employed for high pressures be employed for small low-presure wells, the cost per 1000 cubic feet of compressed air or gas will probably reach seven or eight cents, and at 10,000 cubic feet per barrel the cost would reach 70 to 80 cents, with no allowance for interest or depreciation. On the other hand, gas can be compressed in a compressor direct driven from a gas engine at a cost of three to four cents per 1000 cubic feet and the lifting cost then becomes 30 to 40 cents per barrel, which is considerably lower than would be the cost of a well on the beam, where frequent stoppages are caused by rod breakage, leaky valves, etc."

"We have operated a small well by compressor for 60 days without loss of production for a single day. If now we consider the cost of lifting oil in a well of 100 to 200 barrels per day, total depth of 4000 feet, operated by air-lift and esuipped with tapered tubing of proper design, we would have a gas input consumption of about 2500 cubic feet per barrel, which at three to four cents per 1000 cubic feet would be 7½ to 10 cents per barrel, and there would be infrequent loss of production due to stoppages."

Mountain States Field Development Notes

Iles and Moffat Domes Getting Interest

Denver, Colo.—Interest in the oil industry in Colorado at present is centered in the operatioins on Iles and Moffat domes in the northwestern part of the State. Wells on both structures continue to produce from the Morrison, with a steady flow from the Sundance. Midwest Refining Company has run into more gas and increased oil in its No. 34SD, and drilling is to continue to the Sundance; the 18SD is bottomed at 3400 feet and is flowing 300 barrels per day. No. 4SD is in the top of the Morrison and has a showing of both oil and gas. These wells are on Iles Dome, where the Texas Production Company's Parkinson 1 is drilling below 3350 feet. The hole is full of oil. Parkinson 2 is producing 500 barrels per day from the Morrison. New tests started are: Texas Production Company, two; Midwest Refining Company, one; Yarg Producing & Refining Company, one; J. C. Keith interests, one.

On the Moffat Dome the Texas Company's No. 10 Knowlton is reported drilling in the top of the Sundance at 4400 feet and the company is changing from heavy to lighter tools and stringing up new line. This well is producing from horizon in the Morrison series and this is taken as a good indication that the well will be a producer in the Sundance.

Union to Drill North of Fort Collins

Denver, Colo.—Union Oil Company of California will drill a number of tests on acreage recently acquired in the district north of the Fort Collins oil field. Material is being assembled and drilling will be started as soon as equpment is in readiness.

High Tension Line to Oregon Basin Finished

Cody, Wyo.—High tension transmission lines of the Oil Fields Power Company from the Shoshone Dam to Oregon Basin field are completed and power is being furnished to operators in the field. Ohio Oil Company has not yet made a test of its discovery well on section 8-51-100, and officials have stated that no date for this has been set, or from all indications, will be set this winter. However, the completion of at least three wells in the near future will determine approximately the size of the Ohio well, which is variously estimated from 1000 barrels to 21,000 barrels. Cody Petroleum Company's Clindt 1, section 7-51-100, is drilling at 2000 feet, while Ferdig-Wyoming Oil Company's No. 2 on section 19-51-100, is running close with a total depth at 1920 feet. Cody Petroleum Company's Garner 1, on section 28-51-101, is also in the race for the first completion, its total depth being below 1215 feet.

Producers & Refiners Corporation has secured right-of-way for an oil pipe line which is to be laid from the Torchlight field, east of Basin, to that town. Work on this line is to be started immediately and a loading rack is to be built in the Basin freight yards.

Pondera Dome

Great Falls, Molt.—Interest has been aroused in the Pendroy field, adjoining the Pondera Dome in the Sweetgrass arch on the north and the west, by the activity of the Continental Development Company of California, which is moving in materials on the southeast quarter of the southwest of section 8-25-5w for a test to 2500 feet.

The Fulton and Ferdig wells, near the Pondera discovery, will resume drilling immediately and the Whiteside interests have already resumed. Gas from the Pondera discovery well will be used as fuel for the drilling of the Fulton and Ferdig wells.

On Bannatyne structure three more dry holes have been completed on edge acreage, but within the week completion of two wells which check higher structuarly will be completed and a more definite idea of the possibilities of the structure will be known.

Make Production Test

Salt Lake City.—In an attempt to develop production at the 2600 foot horizon on Cane Creek dome, the Utah Southern Oil Company has announced its intention of going back into the Shafer well in southeastern Utah. The company had another showing at 3600 feet, but this stratum will not be tested at this time, it was said. There is some doubt in the minds of those interested in this test as to its productivity in the higher horizons now. It is argued that it would have made a good producer from this sand when it was drilled, but that now the producing sands will be filled with cement and other foreign matter.

Kevin-Sunburst Output

Great Falls, Mont.—Robert J. Myhrvold, field man for the State Board of Equalization, has recently completed his quarterly inspection trip of the Montana oil fields and according to the figures compiled the Kevin-Sunburst field produced 1,112,928.35 barrels of oil during the quarter ended September 30. This is an increase of 3,948.88 barrels over the production of the quarter ending June 30 this year, when the field accounted for 1,108,979.47 barrels.

Completions Reported in Southwest Wyoming

Kemmerer, Wyo.—California Petroleum Corporation completed a 600-barrel well in its LaBarge acreage last week and the I. Kastor interests completed a 60-barrel producer in the Spring Valley district. These two completions are of the utmost importance at this writing for they come at a time when operations in southwestern Wyoming have been extremely quiet and at times discouraging. The California Company's well is in the heart of the producing territory in the field, and is 400 feet north of the discovery well in LaBarge. Total depth is reported at 950 feet. More encouraging news is that from the Shell's well in section 10-15-116, where a strike is reported at 950 feet, oil is said to have risen more than 500 feet in the hole after having been allowed to stand overnight. This location is in Uinta County near the town of Evanston.

The pipe line from LaBarge to railhead will not be laid until spring, according to definite announcements recently made by officials.

Plan Deep Test

Great Falls, Mont.—Ralph Arnold and Charles A. Mau will start drilling immediately for their test on Six Shooter anticline in township 3 north, range 193, northwest of Billings. This will be one of the deepest tests to be drilled in the State, production not being expected at less than 4000 feet. Drilling will be started with preparations made to continue through the winter. However, weather conditions will very possibly delay the completion until spring.

Third Bannatyne Well

Great Falls, Mont.—The Bannatyne field is reported to have developed a third producer this week with the completion of the S. C. Ferdig well on the northwest quarter of section 12-25-1w at a depth not stated. Location is one mile south and slightly west of the Elliott well drilled in 1-25-1w which was completed a dry hole, and is more than one mile and a half due west of the Genou Oil & Gas Company's discovery well.

Securing Right-of-Way

Denver, Colo.—Right-of-way for the natural gas pipe line from the Texas Panhandle to Denver is being secured It is said that a booster station is to be built on an 80-acre tract near Devine, Pueblo County, Colorado, and that a price of 50 cents per lineal rod is being paid for the right-of-way.

Potrero Well Make Less Than 225 Barrels Initial

(Continued from page 27)

due to the lack of oil and gas showings below the original discovery near 4400 feet. The Miley Oil Company acquired control of the Calnan lease and is completing the well. A fence was built around the rig, but it has been learned that the well is now drilling in a hard, gray sand near 4975 feet. No tests of the showings found above 4500 feet were made. It is generally conceded that the next chance for commercial production will be far below 5000 feet. As a precaution, all available leases have been acquired near the well.

Brea-Olinda

That cluster of prolific old fields, Brea-Olinda, East Coyote, West Coyote, and Richfield, has little spectacular news to excite the public, but the district is producing oil as consistently as it did a year ago. Production varies little from time to time, with nearly 60,000 barrels daily going into the pipe lines. Several interesting deep tests are under way but they have been overshadowed by the sensational developments in the newer fields. This old district has had its heydey and it takes a real discovery to attract much attention. The Shell Company has been one of the most persistent operators to seek production in the deeper sands and is now drilling below 7000 feet in the Brea-Olinda field. The company is also nearing 6000 feet in its deep test on the Puente Hills area, which adjoins the Brea Canyon structure. In the Richfield field, about two dozen wells are being drilled, with the main producing sand found near 4500 feet being the principal objective. The Union Oil Company alone is drilling eight wells while the General Petroleum Corporation, California Petroleum Corporation and Standard Oil Company are each actively developing their holdings. Where the wells are favorably located, the upper sand is being utilized, but many of the edge wells have been carried to the deeper sands. In almost every field in the district a fringe of wells is being drilled to crowd production out a little farther than the present bounds. The water line is well enough defined in some sections, however, to make further extensions doubtful.

Ventura

The Ventura field was extremely quiet during the past week, with no completions and a slight decrease in production. The recent report that the field had been partially shut in was erroneous. The major companies have been working on a plan to curtail production, but no agreements have been reached. About one-third of the production from the majority of the wells was shut in during the summer but the ban was lifted October 1. Another curtailment program would mean a 12,000-barrel reduction in pipe line runs. The Shell Company tested Edison 12 at 6530 feet but the well would not flow. The tubing will be lowered and the well given another chance. The Associated Oil Company's Lloyd 51 and McGonigle 4 are both showing oil, but will not be completed for several hundred feet. The former is temporarily held up, with the drill pipe giving trouble, while the latter is drilling at 5555 feet. G. J. Magenheimer is still clinging to the thought that it may be possible to make a producer of his Hartman 1, which seems to be just outside the producing limits. A plug has been set at 6400 feet for another test. The well was drilled to 7000 feet, but the appearance of salt water indicated that further drilling was practically useless.

Kern Front

The list of completions in the Kern Front field confirms the belief that the area will support several times the present number of wells. It is not the immediate intention of the principal operators to drill the field intensely, but there is little room to doubt that the producing area will eventually be extended on almost every side. Due to a small gas pressure and the low gravity of the oil, it would be almost impossible to upset the oil situation in California with production from the field. It is, nevertheless, a consistent producer and will yield a steady amount of oil over a very long period of time. The field is only a few miles from the old Kern River area, which has produced so many years at a remarkably consistent rate.

The Associated Oil Company, one of the latest entrants into the field, did not seem to be penalized by its tardiness, having completed No. 56, section 23-28-27 as a 300-barrel well. Total depth was 2285 feet. The company has another well ready for completion. The Standard Oil Company, one of the largest operators in the field, completed No. 14, section 15-28-27, at 2250 feet with an initial production of 130 barrels. The oil was 21 gravity and cut six per cent. The Chansler-Canfield Midway Oil Company and the George F. Getty interests did not fare so well, the former completing a 50-barrel producer on section 23-28-27, while the latter secured a 75-barrel well after plugging back from 2800 to 2200 feet on section 14-28-27. These two wells were far below the average and may increase their production as they clean up. The sensation of the field is the General Petroleum Corporation's Sill 13, which has increased its production from 400 to more than 650 barrels in less than a month. The well was recently completed at 2230 feet.

Round Mountain Field Development

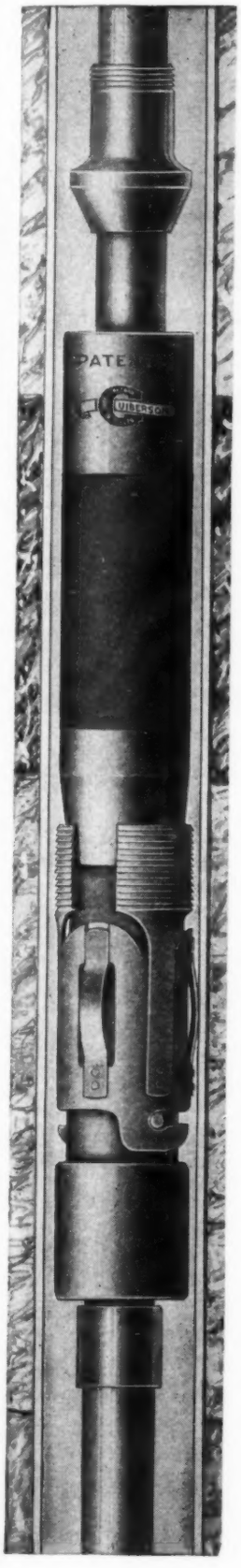
Bakersfield, Calif.—Developments in the Round Mountain field remain practically unchanged from last week. The Elbe Oil Company, discoverer of the field, has recovered the tools and is drilling below 2900 feet in its second test on the structure. The situation is rather a puzzling one, as the well is located only a short distance south of the discovery well, which was a 460-barrel producer at 2167 feet. The second well encountered an oil sand at 2250 feet but water encroachments prevented a successful completion. The St. Helens Petroleum Company is drilling close to 2800 feet on section 13-28-28, but has had nothing more than fair showings where it hoped to obtain production. The Associated Oil Company, without regard to other failures on the northwest flank of the structure, has material on the ground for a test southeast of the Elbe discovery well. The Honolulu Consolidated Oil Company has been negotiating with the Elbe Oil Company toward the purchase of the latter's holdings in the field. The Shell Company, with which the Honolulu Consolidated already has working agreements, probably would receive the oil.

Rincon Well Makes Water

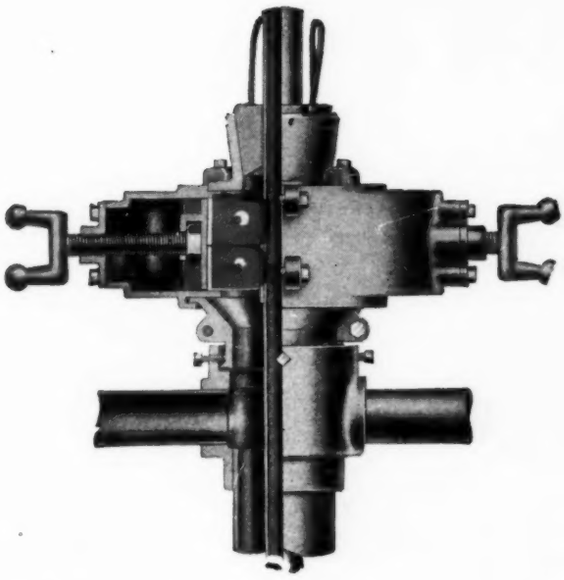
Seacliffe, Calif.—Hard luck continues to camp on the trail of the Chansler-Canfield Midway Oil Company in the Rincon area. Hobson 1A, which showed much promise around 6300 feet, has been swabbed from a total depth of 7002 feet but flowed water. The well has 702 feet of three-inch liner. The latest supposition is that the 4¾-inch casing, which is cemented at 6350 feet, may be faulty. The company is now trying to locate the water. Hobson 1B, which promised to make a commercial well at 4900 feet, is now drilling in the brown shale at 5730 feet. Both wells have attracted much attention, due to the promising sands encountered, but the water problem has not been solved. The Petroleum Securities Company is reaming to set the 13⅜-inch casing at 2786 feet in State 1, which drilled through several strata of oil sands from 2660 to 3162 feet. The well is located almost in the edge of the ocean and seems to be much nearer the center of the structure than the Chanslor-Canfield Midway's Hobson wells.

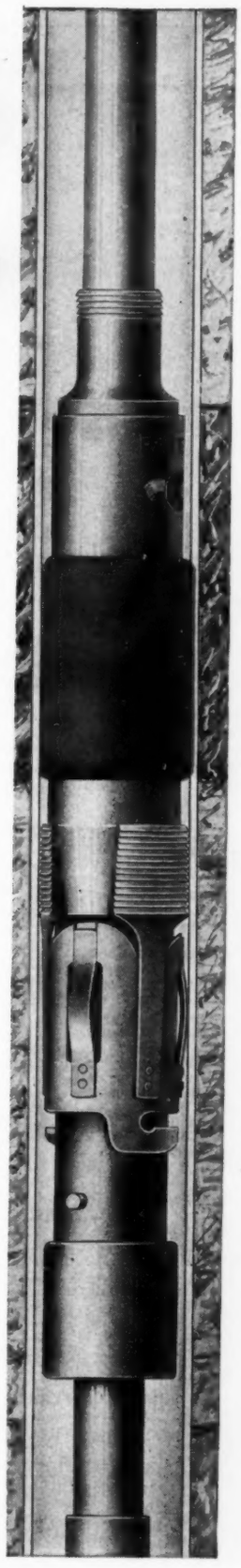
Plan Rivera Wildcat

Los Angeles.—The Associated Oil Company, undaunted by the presence of 18 dry holes little more than a mile away, is preparing to drill a wildcat well in the Rivera district, about nine miles southeast of Los Angeles and only a few miles northwest of the Santa Fe Springs field. The geology has been carefully worker out and the well will be drilled on the theory that a subsurface high area may exist, although the surface hills have been considerably reduced by erosion. The Rivera district, which is practically a continuation of the Bandini area, has attracted considerable attention, but the large number of failures on the eastern fringe has kept a large parcel of land intact.



Saves Gas Pressure-





The GUIBERSON Control Head Packer is especially designed to pack *flowing* wells. It will run in against heavy flows which would prevent the entry of ordinary packers, as it provides a roomy passageway for gas and oil between the packer and tubing, while running in. The operation of setting closes this passage.

By the use of this packer the flow is confined to the string of tubing and the well's gas pressure is imprisoned and maintained until it has been utilized to force a *maximum* yield of oil from the sand. This process also preserves the *gravity* of the oil by maintaing the surface pressure in the well. This packer can be easily opened, reset higher or lower, or withdrawn from the well, —at will.

With the aid of the GUIBERSON Tubing Oil Saver, the packer can be run in without loss of gas or oil. Rubbers permit easy passage of tubing collars, and can be withdrawn into recesses to allow packer or tubing catcher to pass. Both packer and oil saver are fully patented.

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GUIBERSON

BETTER BE SAFE THAN SORRY

Say you saw it in The OIL WEEKLY

United States Daily Average Production

Figures below are taken from the complete revised estimates of the AMERICAN PETROLEUM INSTITUTE except for the current week, which are advance estimates issued by the A. P. I. and are subject to revision:

Month—	Oklahoma	Kansas	Texas (Outside Gulf Coast)	Gulf Coast	North Louisiana	Arkansas	Eastern States	Rocky Mountain	California	United States Ave.	Gross
January, 1926	449,370	100,130	260,180	90,290	43,990	181,190	101,000	102,300	621,300	1,946,980	60,356,380
February	450,037	101,937	245,989	91,550	45,090	169,676	99,000	98,412	605,250	1,909,637	53,469,836
March	454,762	103,300	260,262	92,712	48,787	164,312	97,625	102,325	604,500	1,929,562	59,816,422
April	467,175	101,825	263,612	88,812	50,562	169,824	100,875	106,675	600,000	1,947,387	58,421,610
May	463,750	105,690	277,700	94,550	58,150	175,430	105,700	112,300	602,720	1,995,990	61,875,690
June	456,450	107,637	302,187	89,912	60,412	167,887	106,250	112,925	606,925	2,013,187	60,395,610
July	456,920	110,320	336,600	114,760	57,460	161,870	104,700	108,520	613,940	2,062,470	63,936,570
August	465,137	111,600	381,550	161,237	56,787	157,375	108,350	110,737	609,725	2,162,662	67,042,522
September	465,387	113,037	402,212	175,512	56,575	154,037	110,125	105,825	598,100	2,180,862	65,425,860
October	497,120	114,720	439,490	170,350	58,200	149,810	109,500	99,060	611,600	2,259,850	70,055,350
November	551,225	115,425	475,987	176,425	56,575	144,100	111,125	93,537	641,325	2,365,475	70,964,250
December	561,012	118,950	483,050	181,263	55,137	139,250	110,375	87,650	659,925	2,396,112	71,279,472
January 1927 . .	591,570	117,490	460,910	176,330	53,030	132,648	108,100	83,910	655,660	2,385,650	73,955,150
February.....	683,775	116,200	479,175	154,975	52,850	128,362	107,250	85,237	642,775	2,455,612	69,157,136
March.....	707,187	115,612	475,375	154,262	51,450	124,662	104,500	87,200	644,350	2,462,625	76,341,375
April.....	723,820	115,510	476,920	155,420	50,670	114,860	107,500	89,130	643,520	2,477,350	74,320,500
May.....	716,175	114,675	488,125	151,375	47,465	113,525	113,625	89,625	633,225	2,491,975	77,374,910
June	760,712	112,662	481,950	151,650	48,762	112,612	112,125	85,725	640,325	2,506,037	75,181,125
July	839,580	108,200	476,750	144,110	55,280	110,290	111,700	87,110	621,920	2,554,940	79,203,140
August	837,750	105,187	483,812	138,787	57,375	105,175	114,750	81,837	619,825	2,544,500	78,879,500
September	796,587	105,175	489,137	143,487	53,775	101,637	111,250	73,800	636,750	2,511,650	75,349,500
October 1	809,700	105,000	505,250	140,800	52,350	100,550	110,500	77,500	635,300	2,536,950	17,755,650
October 8	807,000	104,800	506,300	139,550	51,850	100,200	112,000	72,100	633,000	2,526,800	17,673,600
October 15	790,200	104,750	496,750	135,450	51,600	101,050	113,000	72,350	629,200	2,494,350	17,460,450
October 22	779,200	104,950	494,650	617,900	51,050	100,900	114,500	72,950	624,900	2,481,750	17,373,650
Increase	.....	200	.....	900	.....	.....	1,500	600	.....	.....	.....
Decrease	11,000	.....	2,100	.....	550	150	.....	.....	4,300	12,600	88,200

TEXAS

(Outside Gulf Coast)

PANHANDLE DISTRICT

	Oct. 22	Oct. 15
Hutchinson County	65,700	66,300
Gray County	13,500	14,100
Carson County	8,100	8,400
Wheeler County	1,350	1,400
Others	50	....
Totals	88,700	90,200

NORTH TEXAS

Burkburnett	12,900	13,000
Electra	12,500	12,750
Iowa Park-KMA	2,250	2,400
Wilbarger	11,800	12,000
Archer County	23,000	24,800
Clay County (Petrolia)	500	500
Baylor County	100	100
Montague and Cooke Cos.	16,250	16,600
Totals	79,300	82,150

WEST CENTRAL TEXAS

Stephens County	8,500	8,250
Eastland-Desdemona	8,950	8,800
Brown County	20,000	21,500
Coleman County	1,050	1,050
Callahan County	4,000	4,200
Shackelford County	5,000	5,200
Young County	10,000	10,100
Throckmorton County	1,200	1,300
Jack County	800	800
Palo Pinto County	600	600
Others	600	600
Totals	60,700	62,400

WEST TEXAS

Jones County	1,650	1,500
Mitchell-Scurry Cos.	3,650	3,500
Howard County	3,200	3,400
Reagan County	23,400	23,250
Crane-Upton Counties	132,500	132,200
Crockett County	2,100	1,850
Pecos County	31,400	27,100
Winkler County	10,300	10,500
Others	2,800	2,650
Totals	211,000	205,950

EAST CENTRAL TEXAS

Mexia	9,050	9,200
Currie	650	650
Richland	700	700
Wortham	2,600	2,650
Corsicana-Powell	13,850	14,000
Nigger Creek	1,400	1,500
Totals	28,250	28,700

SOUTHWEST TEXAS

Luling	15,000	15,050
Lytton Springs	1,650	1,800
Somerset	850	850
Laredo District	8,500	8,800
Dale	300	400
Others	400	450
Totals	26,700	27,350
T'tl Tex. (Outside Gulf Coast)	494,650	496,750

TEXAS GULF COAST

West Columbia	8,900	9,000
Damon Mound	850	900
Big Creek	3,800	4,600
Boling	2,400	2,400
Blue Ridge	3,500	3,750
Pierce Junction	7,500	7,950
Humble	2,000	2,000
Goose Creek	8,000	7,800
South Liberty	2,000	2,400
Hull	17,050	16,000
Saratoga	1,100	900
Batson	1,300	1,400
Sour Lake	4,200	4,200
Spindle Top	53,550	49,200
Orange County	4,100	4,400
Others	3,000	3,350
Totals	123,250	120,250
Texas totals	617,900	617,000

OKLAHOMA

North Braman	2,550	2,600
South Braman	2,250	2,400
Blackwell	3,950	3,950
Hubbard	3,300	3,750
Thomas	3,050	3,250
Tonkawa	17,900	18,050
Garber	10,200	10,400
Burbank	35,450	35,000
Osage (outside Burbank)	30,650	30,650
Watchorn	1,700	1,800
Cushing	21,250	21,250
Yale Jennings	9,600	9,650
Davenport	2,700	2,800
Bristow Slick	24,850	24,900
North Okmulgee	16,200	16,200
Lyons Deaner	6,500	6,300
Stroud	1,300	1,250
Cromwell	11,450	11,600
Papoose	6,200	6,200
Wewoka	14,200	13,700
Seminole	68,150	68,950
Bowlegs	125,650	130,950
Searight	26,950	29,700
Little River	44,400	39,550
Earlsboro	166,400	172,400
Duncan District	6,950	7,000
Graham	6,500	6,500
Fox	1,900	1,900
Healdton	14,950	15,000
Hewitt	9,400	9,500
Scholem Alechem	13,500	14,000
Others	69,200	69,050
Totals	779,200	790,200

CALIFORNIA

Santa Fe Springs	39,000	39,000
Long Beach	93,000	91,500
Huntington Beach	61,500	63,000
Torrance	20,000	20,500
Dominguez	15,000	15,000
Rosecrans	7,500	8,000
Inglewood	32,500	33,000
Midway-Sunset	84,000	84,000
Ventura Avenue	55,400	56,200
Seal Beach	59,000	62,000
Others	158,000	157,000
Total	624,900	629,200

KANSAS

Florence-Covert	1,500	1,500
Greenwood County	32,350	32,500
Peabody-Ebling	3,850	3,850
Eldorado-Towanda	14,250	14,250
Augusta-Fox Bush	4,250	4,250
Rainbow Bend	2,150	2,100
Russell	2,500	2,500
Churchill	13,800	13,800
Others	30,300	30,000
Totals	104,950	104,750

NORTH LOUISIANA

	Oct. 22	Oct. 15
Homer	4,750	4,750
Haynesville	7,150	7,150
Caddo Light	13,100	13,450
Caddo Heavy	4,550	4,800
DeSoto-Red River	4,300	4,050
Elm Grove	700	650
Bellevue	1,250	1,250
Cotton Valley	5,200	5,150
Urania	9,300	9,300
Pleasant Hill	750	1,050
Totals North Louisiana	51,050	51,600

LOUISIANA GULF COAST

Vinton	4,850	4,950
Lockport	5,600	5,700
Evangeline	1,350	1,300
Edgerly	2,300	1,850
Others	1,300	1,400
Total Louisiana Gulf Coast	15,400	15,200
Louisiana Total	66,450	66,800

ARKANSAS

El Dorado	6,150	6,150
Smackover Light	10,000	10,000
Smackover Heavy	77,450	77,550
Stephens	1,200	1,200
Nevada	2,950	3,050
Lisbon	3,050	3,000
Others	100	100
Totals	100,900	101,050

MOUNTAIN STATES

WYOMING

Salt Creek	32,400	32,600
Grass Creek	2,700	2,600
Elk Basin	1,250	1,050
Big Muddy	2,950	2,750
Lost Soldier	2,350	2,600
Rock River	2,600	2,700
Lance Creek	1,350	600
Teapot Dome	950	850
Others	4,400	4,250
Totals	50,950	50,000

MONTANA

Cat Creek	2,000	2,000
Sunburst	11,500	11,500
Others	200	250
Totals	13,700	13,750

COLORADO

Moffats (Craig)	1,500	1,500
Fort Collins	2,700	2,800
Florence	800	900
Others	1,400	1,200
Totals	6,400	6,400

NEW MEXICO

Table Mesa	100	....
Artesia	1,400	1,400
Hogback	300	250
Rattlesnake	....	400
Others	100	150
Totals	1,900	2,200
Totals Mountain States	72,950	72,350

EASTERN STATES

(Including Ill., Ind., Ohio, W. Va., Pa., Ky., and N. Y.) ..	114,500	113,000

PRODUCTION SUMMARY

East of Rockies.....	1,783,900	1,792,800
United States	2,481,750	2,494,350

Westcott & Greis Service fits your needs—Perfectly

WHEN a Westcott & Greis Engineer is called in for consultation on measurement and control problems, his previous experience in solving such matters enables him to make intelligent, beneficial suggestions. His work in your plant, in no way, conflicts with your own engineering department, or their plans. On the contrary, he is glad to work with your own field and plant men; ready at all times to place himself at their disposal in quickly and economically settling questions pertaining to accurate measurement and absolute control of air, water, gas, steam and oil through his recommendations on equipment and their installation.

When a Westcott & Greis Engineer leaves your plant, he has left a job well done, behind him; he has, in most cases, accomplished an improvement in methods, that will result in distinct savings of time, labor and actual money. If you are facing a particularly knotty problem in your gasoline plant or refinery that calls for experienced advise, you are entitled to the service of a Westcott & Greis Engineer—placing you, of course, under no expense or obligation.

WESTCOTT & GREIS
MEASUREMENT AND CONTROL

Dallas *TULSA* *Los Angeles*

Say you saw it in The OIL WEEKLY

COMPLETIONS FOR PAST WEEK IN U.S. FIELDS

SUMMARIZED REVIEW OF FIELD RESULTS

State—	Completions This Week	Completions Last Week	Producers This Week	Producers Last Week	Gas Wells This Week	Gas Wells Last Week	Failures This Week	Failures Last Week	Initial Production This Week	Initial Production Last Week
Arkansas	6	6	4	4	..	..	2	2	325	584
California	..	24	..	22	..	..	..	2	...	12,695
Colorado	1	3	1	3	..	..	..	..	50	1,100
Indiana	7	6	1	5	4	..	2	1	5	168
Illinois	7	2	3	1	1	..	3	1	37	15
Kansas	7	13	3	6	..	2	4	5	200	385
Kentucky	25	28	16	15	1	1	8	12	1,056	542
Louisiana	13	11	4	5	4	2	5	4	435	310
Michigan	3	3	3	1	..	..	..	2	60	10
Montana	4	12	3	10	1	1	..	1	1.530	1,672
New York	19	19	19	19	..	..	..	..	47	62
Ohio	18	31	12	19	3	5	3	7	374	480
Oklahoma	94	75	56	39	8	11	30	25	35,747	34,178
Pennsylvania	85	66	79	57	6	6	..	3	223	253
Tennessee	2	..	2	..	..	..	..	..	244	...
Texas	93	98	40	54	8	6	45	38	58,120	42,417
West Virginia	14	26	5	7	7	15	2	4	57	106
Wyoming	5	5	4	5	1	..	..	..	1,006	287
Totals	403	428	255	272	44	49	104	107	99,516	95,264
Increase this week	..	..	..	..	..	..	..	..	4,252	...
Decrease this week	25	..	17	..	5	..	3	..	...	...

NOTE—Following is the explanation of abbreviations, signs, etc., used in completion and wildcat reports: *—dry hole, abandoned well; ‡—salt water; †—junked and abandoned; ¶—million cubic feet of gas; abn—abandoned; bbls—barrels; b. s.—basic sediment; csg—casing; co—cleaning out; dk—derrick; dr—drilling; fsh—fishing; ft—feet; in—inches; loc—location; m—milling; n, s, e, w—north, south, east, west; r—reaming; sd—shut down; sdtr—sidetracking; sp—spudding; sr—straight reaming; std—standardizing; sw—salt water; td—total depth; ur—underreaming; wo—workover; wosr—waiting on standard rig.

OKLAHOMA

Company, Well and Location	Initial Production Bbls.	Depth
BECKHAM COUNTY—		
Bucy & Clay, Hawkins 1, ne sw ne sw ne 21-9-23	¶40	2705
CADDO COUNTY—		
Rome, Moran & Jackson, Parks 1, se ne nw 5-5-9	25	2410
CARTER COUNTY—		
Wirt Franklin & Prairie O. & G. Pruitt 6, ne nw nw 3-2-3	15	2921
CREEK COUNTY—		
Redister Oil Co., Murrell 3, c se nw 17-19-9	10	2242
Evans Bros., Cares 1A, nw c se 31-19-9	¶10	2487
Kennedy, Horner et al, Burnett 1, sw c 24-18-11	¶3	1900
Dixie Drilling Co., Bowlegs 3, ne se se 1-17-9	20	1806
O. M. Irelan, Farley 3, nw se ne 13-17-10	75	1889
Ted Ray Oil Co., Brink 6, ne c se sw 13-17-10	35	2472
Future Dev. Co., Behen 2, c se nw 2-16-11	25	2645
Wilcox O. & G. Co., Dixon 3, ne c nw se 18-14-10	600	3411
Sapulpa Fuel Co., Washington 1, ne c 19-18-9	*	2990
A. B. Ice, Townlot 1, ne ne 6-18-12	*	....
Thompson & Black, Wilson 4, nw c se sw 16-17-11	*	2000
Kawfield Oil Co., Bowers 1, ne c nw sw 23-16-10	*	3454
GARFIELD COUNTY—		
Chas. E. Knox, Crooks 6, ne c se sw ne 26-22-4	*	1960
Crooks 7, sw c ne 26-22-4	*	1825
Crooks 8, ne c sw sw ne 26-22-4	*	1775
GRADY COUNTY—		
Gant et al, Pursley 1, se c nw 17-4-6	¶11	1824
Marland, Burke 1, se c ne 17-3-5	85	2302
Magnolia, Mitchell 4, sw ne nw 34-3-5	*	3562
GRANT COUNTY—		
Kay Oil Co., Elswick 1, sw c se sw 14-27-3	660	4081
KAY COUNTY—		
Comar Oil Co., Garrett 1, ne c nw se 31-27-2	50	2465
Anderson & Peterson, Myer 1, sw se sw 31-27-2	*	651
Larutan Fuel Co., Woods 4A, se ne nw 30-2-1	*	802
MUSKOGEE COUNTY—		
Sioux Oil Co., Kelly 3, cnl ne nw 24-13-18	¶1	540
Sunray Oil Co., J. Crittendon 9, ne c nw nw sw 5-14-19	40	742
J. R. Parks, Vann 1, sw c nw sw se 24-15-19	*	1866
OKFUSKEE COUNTY—		
J. Hartman, Holmes 1A, nw ne ne 27-12-11	*	2808
L. W. Umburn, Fields 2, sw c nw 31-10-12	*	3055
OKMULGEE COUNTY—		
McNutt & Davis, Eubanks 1, sw c ne ne 17-13-14	2	1229
J. E. Wallace, Dolbert 3, csl nw se 14-14-14	10	1009
W. B. Pine, Skidmore 1, se c nw 10-15-14	15	994
Misner & Mid-Continent, Lowery 1, ne c sw 10-15-14	40	999
Harsha & Delaney, Bruner 2, csl sw ne 34-16-14	10	1877
Tiger Mountain Oil Co., M. Simer 1, ne c 19-12-13	*	2982
OSAGE COUNTY—		
Gault Brown, 1, sw se sw 3-26-5	35	2836
Kewanee O. & G. Co., 3, sw se ne 3-26-6	1200	2830
I. T. I. O. 372, ne c nw se 22-27-11	35	1692
PAWNEE COUNTY—		
Magnolia, Wineare 1, ne c nw 10-22-4	*	4745
Garber & Pulse, Moore 1, sw c nw 9-22-6	*	3525
PONTOTOC COUNTY—		
Homa Okla Oil Co., Milner 2, nw sw nw 16-5-8	150	2499
POTTAWATOMIE COUNTY—		
Amerada, Cowden 6, nw se sw 4-9-5	300	4345
Gypsy, Hunick 1, cwl sw se 5-9-5	607	4462
Indep. O. & G. Co. & Darby Pet. Co., Knapp 6, nw ne ne 8-9-5	575	4387
Indep. O. & G. Co. et al, Brown 2, nw sw nw 14-7-4	200	3748
Twin State, Spangy 3, nw sw se 19-7-4	80	3765
Gypsy, McFarland 4, ne sw sw 9-9-5	*	4445
Pierce Oil Corp., Sanders 1, nw c sw 20-7-4	*	....
SEMINOLE COUNTY—		
Barnsdall, N. Bruner 3, se ne ne ne 10-9-5	3640	4296
Gypsy, Bruner 4, se nw ne 10-9-5	1845	4358
Carter 8, ne se nw 11-9-5	765	5621
Indep. O. & G., Gaines 4, sw ne ne 11-9-5	1100	4410
Magn'a, Sparks 7, sw nw sw 11-9-5	2225	4288
Continental, Hollins 4, ne se nw 12-9-5	4500	4254
Magnolia, Seay 2, se sw sw 12-9-5	890	4317
Twin State, Barker 4, se nw ne 12-9-5	2695	4248
I. T. I. O., Allen 1, sw c ne 25-9-6	685	4281
Allen 2, se sw ne 25-9-6	180	4391
Carter, Jackson 1, se sw ne 27-9-6	135	4267
Sinclair, Taylor 4, ne nw se 10-8-6	500	4124
Ellen 5, ne nw sw 11-9-6	275	4346
Gypsy, Grayson 4, ne nw nw 13-8-6	920	4220
Henderson 1, nw ne ne 13-8-6	¶45	4377
Tidal Oil Co., Grayson 2, ne c nw 13-8-6	1213	4344
Grayson 3, nw ne nw 13-8-6	635	4238
Empire G. & F. Co., Lacey 6, ne nw sw 14-8-6	230	4373
I T. I. O., Dungan 2, ne sw se 35-8-6	1130	4345
Gypsy, Campbell 1, sw nw se 36-8-6	1575	4422
Magnolia, Bagwell 3, sw c sw sw nw 32-8-8	70	4010
I T. I. O., Soketheche 5, ne nw ne 1-7-6	1380	4210
Tidal Oil Co., Jackson 1, se ne nw 1-7-6	1165	4439
I T. I. O., House B 1, ne c se 2-7-6	2275	4381
Gypsy, Cudjo 3, se sw ne 4-9-6	370	4409
Carter, Davis 7, se c ne 4-9-6	245	4533
Amerada, Johnson 2, nw ne se 4-9-6	70	4520
Magnolia, Bullock 1, se c 18-7-5	30	3930
Keiner 1, sw c 17-7-5	48	4134
Guy Swain, Dindy 1, se c 20-6-7	*	4558
T. B. Slick, Harjo 1, se sw sw 1-6-6	*	4156
Gypsy, Wakkie 1, se ne sw, 35-8-6	*	4292
Empire G. & F., Wise 3, se c nw 23-8-6	*	4700
Magn'a, Strothers 1, se c nw 17-8-6	*	4427
Philmac Oil Co., Sango 1, se ne nw 1-9-5	*	4350
Continental, Blevins 1, sw nw sw 28-10-7	*	4660
STEPHENS COUNTY—		
Magnolia, Harrell 1, ne c sw sw 3-1-5	¶6	3725
Payne 1, se c ne 31-1-5	5	1867
Owen & Wood, Massey 3, nw se nw 12-2-8	50	2079
Magnolia, Creel 1, nw ne se 31-1-5	*	2312
TULSA COUNTY—		
Sheridan Oil Co., Russell 3, se ne ne 27-19-11	¶2	1792
Hivick et al, Unallotted 1A, nw sw nw 14-18-12	*	2212
WAGGONER COUNTY—		
C. R. Cane et al, Barnett 1, sw c ne 36-17-17	*	840
W. R. Rowland et al, E. Johnson 1A, se c sw se 31-18-15	*	1355
Cartwright & Kyle, Luckey 4, csl se sw 11-18-15	*	1480

KANSAS

Company, Well and Location	Initial Production Bbls.	Depth
BUTLER COUNTY—		
Magnolia, Shriver 4, nw c 34-27-6	50	3062
CHASE COUNTY—		
Preston & Pasewalk, Lipps 6, sw ne 36-18-6	*	1248
GREENWOOD COUNTY—		
Empire O. & R. Co., Fankhouser 3, se c sw se 24-22-12	50	1772
McGinnis et al, Furgeson 2, nw c se sw 4-27-11	100	1842
Phillips Pet. Co. et al, Beam 1, sw c ne 35-23-8	*	2479
Bement Oil Corp. & Smalley, Snyder 1, ne c se nw 7-25-11	*	2049
McPHERSON COUNTY—		
Laughlin et al, Ross 1, se c 30-21-5	*	3540

MOUNTAIN STATES

MONTANA

Company, Well and Location	Initial Production Bbls.	Depth
KEVIN-SUNBURST—		
California Co., Lorenson 16, 28-25-2w	1400	1453
Homestake Ex. Corp., Howling 7, 9-35-2w	125	1697
State 42, 36-35-2w	5	1460
General Oil, Wilcox 1, 8-34-1w	¶2½	1190

WYOMING

Company, Well and Location	Initial Production Bbls.	Depth
SALT CREEK—		
Midwest Ref. Co., Midwest Oil 33L, ne 23-40-79	10	2500
Wyoming Assn. 3L, se 23-40-79	346	2500
BILLY CREEK—		
Carter Oil Co., Rider 2	¶60	....
SPRING VALLEY—		
I. Kastor, 10-14n-118	50	1900
LA BARGE—		
Calif. Pet. Corp., 34-27-113	600	985

COLORADO

Company, Well and Location	Initial Production Bbls.	Depth
Great Basin Oil Co., Ute 7, 7-18w	50	630

ALLIED

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Prosser Socket Licensees

Alamo Iron Works.
Algyre Machine.
Bovaird & Seyfang.
Breckenridge Fishing Tool Company.
Bridgeport Machine Co.
Brown Welding Works.
Cree & Gallagher.
Crotty & Company.
Cushing Machine & Tool.
Dunnigan Tool & Supply.
Eldorado Machine & Tool.
Fairport Machine Co.
Farley Machine Works.
Federal Supply Co.
Ft. Worth Drilling Tool.
Hinderliter Tool Co.
Larkin & Co.
Larkin Packer Co.
Leidecker Tool Co.
Lone Star Tool Co.
Lucey Manufacturing Co.
Magnolia Petroleum Co.
Mid-West Refining Co.
Murray Tool Co.
Muskogee Tool Co.
Norwalk Drilling Tool Co.
O. C. S. Mfg. Co.
Oil Well Supply Co.
Oklahoma Iron Works.
Chas. Phillips.
Regan Forge and Engineering Co.
San Antonio Machine Co.
Star Drilling Machine.
Titusville Forge Co.
Union Tool.
Union Tool, Torrance.
Western Drilling Tool Co.
Western Supply Co.
Wright Tool Co.
Oil Well Engineering Co.-Cheadle Heath, England
Vickers Ltd. London.

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TULSA, OKLA.

EASTERN STATES

Company, Well and Location	Initial Production Bbls.	Depth
BRADFORD FIELD—		
South Penn Oil Co., Bingham 439 tr 103	3	....
Bingham 88, tr 15	2	....
Bingham 400, tr 86	2	....
Bingham 533, tr 1	2	....
Bingham 398, tr 1	2	....
Bingham-Satterfield 125	2	....
Fee 37	2	....
Fee 38	2	....
Middaugh 57	2	....
Middaugh 59	2	....
Jones 236	2	....
Jones 237	2	....
Jones 238	2	....
Hooker 22	2	....
Hooker 23	2	....
Kendall 68	2	....
Cotton 63	2	....
Cotton 64	2	....
Melvin 202	2	....
Melvin 203	2	....
Blair 58	2	....
Forest Oil Corp., Tyler 206	3	....
Forest 304	3	....
Forest 307	3	....
Forest 309	3	....
Forest 310	3	....
Forest Pet. Co., Drake 1-G20	3	....
Drake 1-[illegible]	3	....
Taylor 1-[illegible]	3	....
Taylor 1-[illegible]	3	....
Taylor 1-[illegible]	3	....
Taylor 1-[illegible]	3	....
Sima 1-[illegible]	3	....
J. A. Hooper, Bingham 428, tr 13	2	....
T. H. Kennedy, Bingham 490, tr 2	2	....
Kennedy 36	2	....
Elder & Hooper, Bingham 392, tr 27	7	....
D. W. Daly, Bingham 389, tr 1	3	....
W. Piper & Co., Piper 1	3	....
G. W. Crooks Estate, Crook 2	3	....
C. S. Knabb, Trustee, Griffith 2	7	....
Zook & Sloan, Keating 20	3	....
D. A. Stover, Sanderson 2	3	....
B. Devlin, Devlin 1	3	....
Skag Bros, Skag 1	7	....
N. V. V. Franchot, Rounds 8	3	....
Penn Oil P. & R. Co., Fee 8	3	....
Fee 9	2	....
C. H. Williams, Moore 2	3	....
W. J. Gealey, Gealey 2	3	....
M. L. Boyle, Duke 7	3	....
Duke 8	2	....
I. A. Mazza & Co., Burns 1	3	....
J. E. Karl & Co., Hamlin 2	3	....
Pressure Oil Co., Howard 8	2	....
Howard 9	2	....
Piper & Lloyd Ekas 41	2	....
Ekas 42	2	....
T. H. Kervin, Berry 1	3	....
Wright & Saph, Bingham 394, tr 4	3	....
George Bovaird, Bingham 391, tr 1	2	....
S. H. Elder & Co., Elder 4	2	....
J. E. Ward, Bingham 401, tr 18	2	....
F. B. Hazzard & Co., Grant 1	2	....
Ass'd Prod. Co., Bingham 184 tr. 1	3	....
Bingham 582, tr 1	3	....
L. & A. L. Lilly, Middaugh 12	3	....
CENTER-MIDDLE FIELD—		
Titusville Trust Co., Jennings 32	5	....
Rembold & Co., Osgood 18	7	....
Pennsylvania Gas Co., Howe 1044	¶1	....
Kinzue Chemical Co., Lot 40, tr 1	¶¼	....
S. L. Bemis, Miller 5	2	....
BUTLER COUNTY—		
Burns, Sutton & Co., McKinney 3	3	....
Shoup & Co., Shoup 1	4	....
Greibb & Co., Scabrick 1	¶1½	....
CLARION COUNTY—		
Sweitzer, Klinger & Co., Schuey 2	2	....
I. C. Hess, Berlin 3	¶1¼	....
VENANGO COUNTY—		
L. Roess & Co., Sheasley 20	3	....
Hutchison & Eakin, Plumer 6	3	....
F. E. & W. B. Kapp, Kapp 9	2	....
E. A. Burch & Co., Porter 95	2	....
J. B. Porter, Porter Heirs 24	2	....
United Nat. Gas Co., Blauser 3828	¶1½	....
GREENE COUNTY—		
John Blair, John Blair 2	¶¼	....
WASHINGTON COUNTY—		
Wasco F. Co., Citizens Water Co. 1	8	....

NEW YORK

Company, Well and Location	Initial Production Bbls.	Depth
ALLEGANY COUNTY—		
Forest Oil Corp., Forest 310	3	....
Forest 313	3	....
Forest 315	3	....
Forest 317	3	....
Empire G. & F. Co., Empire 23	5	....
Dermitt & Gilligan, Dermitt 1	3	....
Forest Trust Co., South Penn 94	3	....
C. M. Lippert, Lippert 10	2	....
Lippert 11	2	....
H. C. Miller & Co. Gallets 1	2	....
E. L. & H. F. Carls, Carls 4	2	....
Leland Oil Co., Leland 5	2	....
S. E. Wakeman & Co., Wakeman 1	2	....
H. Randall, Reed 1	2	....
B. D. Turner, Turner 1	2	....
J. M. Hughes & Co., Hughes 1	2	....
M. Shear, Fish 1	2	....
P. & G. W. Burtcel, Burtcel 1	2	....
J. E. LeSuer & Co., LeSuer 4	2	....
WEST VIRGINIA		
CABELL COUNTY—		
Harshbarger O. & G. Co., J. Harshbarger 4	¶¼	....
Pittsburg & W. Va. Gas Co., T. Brown 1	¶¼	....
Grant Shipe & Co., U. G. Plyon 1	¶1½	....
ROANE COUNTY—		
Noble Beattie, Julie Bent 1	¶½	....
So. Penn Oil Co., O. D. Stockley 61	10	....
LEWIS COUNTY—		
Hope Nat. Gas Co., Roarbaugh 1	5	....
Hull 1	*	....
RITCHIE COUNTY—		
Swingle & Co., Templeton 1	*	....
Little & Trainer, Charles Pearey 1	¶1	....
CLAY COUNTY—		
Virginian G. & O. Co., Summers 3	35	....
WOOD COUNTY—		
South Penn Oil Co., Altman 2	5	....
PLEASANTS COUNTY—		
L. C. White & Co., Dennie 1	2	....
DODDRIDGE COUNTY—		
Mfrs. L. & H. Co., Ford 1	¶¾	1947
HARRISON COUNTY—		
Clarksburg L. & H. Co., Core Hrs. 254	¶1½	....
KENTUCKY		
DAVIESS COUNTY—		
Thompson & Co., Mattingley 1	10	....
METCALF COUNTY—		
Samson Mitchell & Davis, Price 1	¶2	270
BARREN COUNTY—		
Samson Oil Co., Loden 4	20	....
Loden 5	20	....
Hunt, Mitchell & Leach, Browning 2	20	....
Ogle & Co., Christ Ellis 3	6	....
Fred C. Moore, Hayde Myers 1	5	....
J. D. White, Burks 2	*	....
Phil Kopel, Reeves 2	*	....
Sandals & Co., Shirley 1	*	....
J. C. Esslinger, Pulliam 1	*	....
Gooden 1	*	....
OHIO COUNTY—		
Wood Oil Co., J. C. Smith 2	150	421
Mary Elmore 18	200	756
Penn-Indiana Oil Co., Kelly 5	20	....
Kelly 6	60	....
Daugherty & Co., Wells 5	200	684
Creek Drlg. Co., Lake 11	200	760
White Plains O. & G. Co., Howard Hrs. 5	20	446
Dodson 1	*	751
Earl Patton, Wilson 3	100	450
Guerney Dev. Co., Bartlett 1	15	....
Leeper Oil Co., King 1	10	....
F. Heine & Co., Jewell 1	*	....
Bolling & Co., J. Chapman 2	*	....
TENNESSEE		
CLAY COUNTY—		
Brandenbury & Co., Holmes 2	144	....
Pratt & Co., Williams 3	100	....
NORTHWESTERN OHIO		
MERCER COUNTY—		
W. B. Lawrence & Co., Fireovid 1	15	1200
Gailey Myers, Wenning 5	2	1160
SENECA COUNTY—		
Great Northern O. & G. Co., Deppen 1	*	1998
WOOD COUNTY—		
W. J. Lyons & Co., Dailey 1	10	1239
SANDUSKY COUNTY—		
F. Haubert & Co., Havens 3	5	1311

SOUTHEASTERN OHIO

Company, Well and Location	Initial Production Bbls.	Depth
BELMONT COUNTY—		
C. O. Moore & Co., Carpenter 1	10	....
Natural Gas Co., of W. Va., During 3	10	....
Weaver 6	10	....
CENTRAL OHIO		
HOLMES COUNTY—		
Kemrow Co., Ledbetter 1	¶4	....
Arkansas F. O. Co., Miller 4	125	....
LICKING COUNTY—		
Hope Cons. & Ref. Co., Fleming 1	93	....
A. H. Heisey Gas Co., Davis 1	¶½	....
COSHOCTON COUNTY—		
Logan Gas Co., Sells 1	90	....
Empire G. & F. Co., Brush 1	*	....
MEDINA COUNTY—		
E. R. Edson & Son Co., Wertz 31	2	382
Wertz 32	2	378
CUYAHOGA COUNTY—		
Empire G. & F. Co., Whitney 1	¶1	....
MEIGS COUNTY—		
Ohio Fuel Sup. Co., Williamson-Moore 1	*	....
INDIANA		
DAVIESS COUNTY—		
J. F. Arnold & Co., Walton 1	¶2	....
Hartman, Sargent & Co., Barber 1	*	1150
HARRISON COUNTY—		
Louisville G. & E. Co., G. B. Melton 1	¶¾	....
WAYNE COUNTY—		
Chas. Teeters, Teeters 1	¶½	....
HANCOCK COUNTY—		
Vernon Gas Co., McCordsville 1	¶¾	....
ADAMS COUNTY—		
McKelvey Bros., J. Brown 1	5	....
HAMILTON COUNTY—		
Sheridan Oil & Gas Co., Stephen Cox 1	*	....
ILLINOIS		
CRAWFORD COUNTY—		
Selby-Cisler Prod. Co., Cawood Hrs 8	5	992
Robinson Gas Co., McCarty Lot 1.	¶¼	956
WABASH COUNTY—		
J. S. Young & Co., J. Keyser 6	30	1478
ADAMS COUNTY—		
Cole & Weber, W. Powell 1	*	850
CUMBERLAND COUNTY—		
P. J. Campbell, George Kuhn 2	2	545
MARION COUNTY—		
Mt. Vernon Dev. Co., A. Sebastion 1	*	2280
McDONOUGH COUNTY—		
Zemple & Co., D. E. Vol 1	*	970
MICHIGAN		
SAGINAW COUNTY—		
Saginaw Prosp. Co., Eddy Est. 5	20	1826
Wells-Schmidt Co., Whittier 5	20	1830
Wickes Bros., Wickes 3	20	1830

ARKANSAS

Company, Well and Location	Initial Production Bbls.	Depth
NEVADA COUNTY—		
Humble, Fairchild 1, 6-14-20	50	1191
J. J. O'Brien, Haynie B-3, 1-14-21	100.	1163
OUACHITA COUNTY—		
Owenwood Oil Corp., Snyder 2, 34-15-15	75	2292
UNION COUNTY—		
Skelly Oi lCo., Roper 12, 3-16-15	100	2375

LOUISIANA

Company, Well and Location	Initial Production Bbls.	Depth
CADDO PARISH—		
Standard, Stiles 189, 27-21-16	40	1836
OUACHITA PARISH—		
C. W. Frierson, Feazel 1, 17-19-4e	¶11	2165
Louisiana Dev. Co., Fee 44, 6-19-5e	¶9	2175
RICHLAND PARISH—		
Moody & Seagraves, McCoy 1, 36-16-6e	¶19	2433
WEBSTER PARISH—		
Magnolia Waller Obrier 1, 32-23-9	¶12	2665
SOUTH LOUISIANA		
EDGERLY—		
McDaniel & Ellis, Ecker 1	*	3750
EVANGELINE—		
The Texas Co., Latrielle B-2	10	1975
LOCKPORT—		
Vacuum-Gulf, Bordages 5	145	3750
Fee A-1	240	3840

BOVAIRD *Grip* CASING ELEVATORS *and* SPIDERS *are safe and speedy*

— these two advantages under all conditions encountered in running and pulling have led careful operators to Insist on BOVAIRD when their wells are equipped with ELEVATORS and SPIDERS

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TULSA

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TEXAS

GULF COAST

Company, Well and Location	Initial Production Bbls.	Depth
SPINDLE TOP—		
Gulf, Mann 7	1500	4175
BATSON—		
J. R. Everett, King 2	*	900
GOOSE CREEK—		
Gulf, Ashbel-Smith 26	*	5250
HULL—		
Republic Prod. Co., Dolbear 99	60	2500
NASH—		
Rycade, Wisdom 17	450	3931
ORANGE—		
Gulf, Hager Fee 19	95	4200
Rex Pet. Co., Cargello 6	*	3550
Texhoma Oil Co., Chesson 8	*	3050
Rycade, Cow Bayou B-11	1500	4188

EAST TEXAS

HARRISON COUNTY—		
Jim Clark, Furrh, Jones 1, R. W. Bedford sur	¶1	1942
PANOLA COUNTY—		
Magnolia, Baker 2, B. C. oJrdan sur	¶4½	979

WEST TEXAS DISTRICT

UPTON COUNTY—		
T. P. Coal & Oil Co., Burleson 1	25	2095
CRANE COUNTY—		
Landreth, State Land 16	90	2938
Pecos Oil Co., University 10	125	3020
PECOS COUNTY—		
The California Co., Yates 3	14,400	1205
Humble, Smith 1	2088	1600
Marland & McMan, Yates 2	13,080	1291
Yates 5	3900	1695
Yates 6	5180	1632
Mid-Kans & Transcontinental, Smith-Taylor 2	2640	1374
Roxana, Smith 1-A	10,030	1562

PANHANDLE DISTRICT

CARSON COUNTY—		
The Texas Co., M. P. Co. Fee 4	30	3162
GRAY COUNTY—		
Amos et al, Crews 1	10	3005
HUTCHINSON COUNTY—		
Empire G. & F. Co., Johnson Bros. 7 "B"	*	2016
Great Plains Oil Co., Lee Bivins 1	¶80	3135
Phillips & Gibson, Whittenburg 13	300	2713
The Texas Co., Lewis 3	15	3084
WHEELER COUNTY—		
Piney Oil Co., M. E. Ackley 1	¶81	1978
SHERMAN COUNTY—		
Marland et al, Flores 1	*	4003

CENTRAL WEST TEXAS

BROWN COUNTY—		
Bowers, Gason Jr. 3	90	1525
Cranfill & Reynolds, Smith 9	390	1361
Curtis & Pandem Oil Co., Moore 1	*	1128
Humble, Armstrong 11	259	1220
Kon Prod. Co., Hickman 6	35	1228
Kent Bros., Armstrong 1	*	1548
Mitcham, Keeler 1	*	2037
Phillips, Newsome 3	10	1346
Ross Dr. Co., Spencer 1	*	1227
Sinclair, Smith 8	250	1339
E. L. Smith, Smith 5	10	1357
Smith 9	155	1359
Smith 19	385	1356
Veale et al, Wooldridge 9	*	1284
Vondran et al, Lewis 2	*	1222
Golden Rod Oil Co., Taylor 1	¶	1567
J. H. Shell, McGauhey 1	*	1109
Van Bibber & Lehman, Evans 1	*	1612
Warren Dev. Co., Ratliff 1	*	1350
CALLAHAN COUNTY—		
Denny & Andrews, Beck 1	*	1115
Sterling Oil Co., Hatchett 1	*	840
EASTLAND COUNTY—		
Allworth Bros., Clemmer 1	*	1310
Barkley et al, Duffer 1	161	2998
Lewis et al, Johnson 2	¶	1731
Teatsworth et al, Hargus 2	*	1573
The Texas Co., Hightower 18	*	1216
Hightower 19	30	1208
Thomas & Reynolds, Chesley 1	¶	3827
McCULLOCH COUNTY—		
Wakefield et al, Dutton 1	*	814
Ragsdale et al, Dutton 1	¶	775

NORTH TEXAS DISTRICT

Company, Well and Location	Initial Production Bbls.	Depth
ARCHER COUNTY—		
Stidham & Thrasher, Allen 1	*	2500
Sammon et al, Kemp & Keel 3A	1	160
Clark et al, Donnell 1	*	1335
Maer & Staniforth, Seay 1	*	1603
Robert Oil Corp., Garvey 2	37	772
Underwood Drlg Co., Ward 5	*	1025
COOKE COUNTY—		
Fain-McGaha Oil Corp., Harris 1	*	2027
Stoneman et al, Harris 1	*	2005
GRAYSON COUNTY—		
Richardson Bros., Taylor 1	*	2545
JACK COUNTY—		
Buttram Pet. Co., Jones Estate 3	120	2007
Craig-Towne & Walton, Coats 2	14	499
Holman Bros., Fee 3	100	2016
HASKELL COUNTY—		
Kouri et al, Wright 1	*	2008
Marland-Texas, Clark 1	*	2503
MONTAGUE COUNTY—		
Pace et al, Cobb 1	*	2008
Yates & Crumley, Tinney et al 1	*	480
PALO PINTO COUNTY—		
DeWitt et al, Humphries 1	*	1500
Richardson & Dalton, Edgin 1	13	1418
SHACKELFORD COUNTY—		
Merry Bros. & Perini, Huskey 1	*	492
WICHITA COUNTY—		
Humble, Chilson A-2	*	741
YOUNG COUNTY—		
The Texas Co., Campbell 1	*	1162
Hines & Whatley, Griswell 1	30	3005
Nance & Lucas, Boozer 2	*	3030
Panhandle Ref. Co., McCluskey 17	60	3965
Sun, Donnell 6	125	3338

Crude Stock Changes for September

New York.—Pipe line and tank farm gross domestic crude oil stocks east of the Rocky Mountains increased 5,235,000 barrels in the month of September, according to returns compiled by the American Petroleum Institute from reports made to it by representative companies. The net change shown by the reporting companies accounts for the increases and decreases in general crude oil stocks, including crude oil in transit, but not producers' stocks at the wells.

Stocks at Refineries Less In September

New York.—The following is the American Petroleum Institute's summary for the month of September of the increases and decreases in stocks at refineries covering approximately 87 per cent of the operating capacity east of California.

	Increase Bbls. of 42 Gals.	Decrease Bbls. of 42 Gals.
Domestic crude oil	1,445,000	.....
Foreign crude oil	.....	75,000
Gasoline	.....	2,257,000
Kerosene	.....	523,000
Gas and Fuel oils	1,697,000	.....
Lubricating oil	.....	30,000
Miscellaneous	.....	1,076,000
Total	3,142,000	3,961,000
Deduct	.....	3,142,000
Net Decrease	.....	819,000

Chamber of Mines and Oil Plans Building

Los Angeles.—The Chamber of Mines and Oil held its first luncheon of the fall series October 18 at the Biltmore hotel. The principal matter discussed was the feasibility of the erection of a new 13-story Class A office building to house the organization and provide spacious quarters for other suitable tenants. It was brought out that enough outside capital had been interested to erect the building if the members of the chamber could secure tenants for at least 75 per cent or the total space. Joseph Scott, formerly president of the Los Angeles Chamber of Commerce and one of the guiding spirits in the erection of the magnificent Chamber of Commerce building in Los Angeles, was the principal speaker. He urged the erection of the building, saying that the organization was on a firm footing and influential enough to foster such an undertaking. Dick Guiberson acted as toastmaster and scored a great hit with his review of that thrilling poem, "Mary Had a Little Lamb." Other entertainment was provided. Chester Brown, president of the chamber presided.

Gets Pumper at Sulphur Mountain

Los Angeles.—Geis & Bradford, independent operators, apparently have a commercial well on the Sulphur Mountain structure, which is located in the Santa Paula area. On a pumping test, the well produced 180 barrels in 12 hours. The crude is 19 gravity, contins 20 per cent gasoline, 10 per cent kerosene and is clean. The producing sand is 100 feet thick.

Plugged Back

Bakersfield, Calif.—The status of the Pacific Eastern Production Company's Union Avenue well, near this city, remains practically unchanged. The immediate plans call for the running of a 4½-inch liner to the top of the plug, which was set at 4415 feet. The well produced a large quantity of gas and a little oil at 4393 feet, but failed to produce consistently. The gas flow has diminished and little oil is in evidence. The company drilled the well to 4500 feet without results and pluged back in the hope of making a producer near the old level.

Inspection Tour

Denver, Colo.—A party of eastern capitalists recently made a tour of inspection of the oil and gas properties of the Reiter-Foster Oil Corporation in the Rocky Mountain region. The group visited in Denver, Rock Springs, Wyoming, the Hiawatha Dome acreage and then returned to Chicago, from whence they went on to Boston and New York.

Oil Fields are Timken Fields

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In crown blocks, swivels, sucker rod apparatus, and other hard-worked equipment that must not fail, Timken Tapered Roller Bearings are fast becoming the universal standard. The virtual elimination of friction and power waste is not the only reason. Timkens are also giving oil operators the most consistent and most nearly attentionless service ever known in the field.

Only Timken thrust capacity can do it. Only Timken Tapered construction, *POSITIVELY ALIGNED ROLLS*, and electric steel provide for thrust and all other load elements without compromise or complication.

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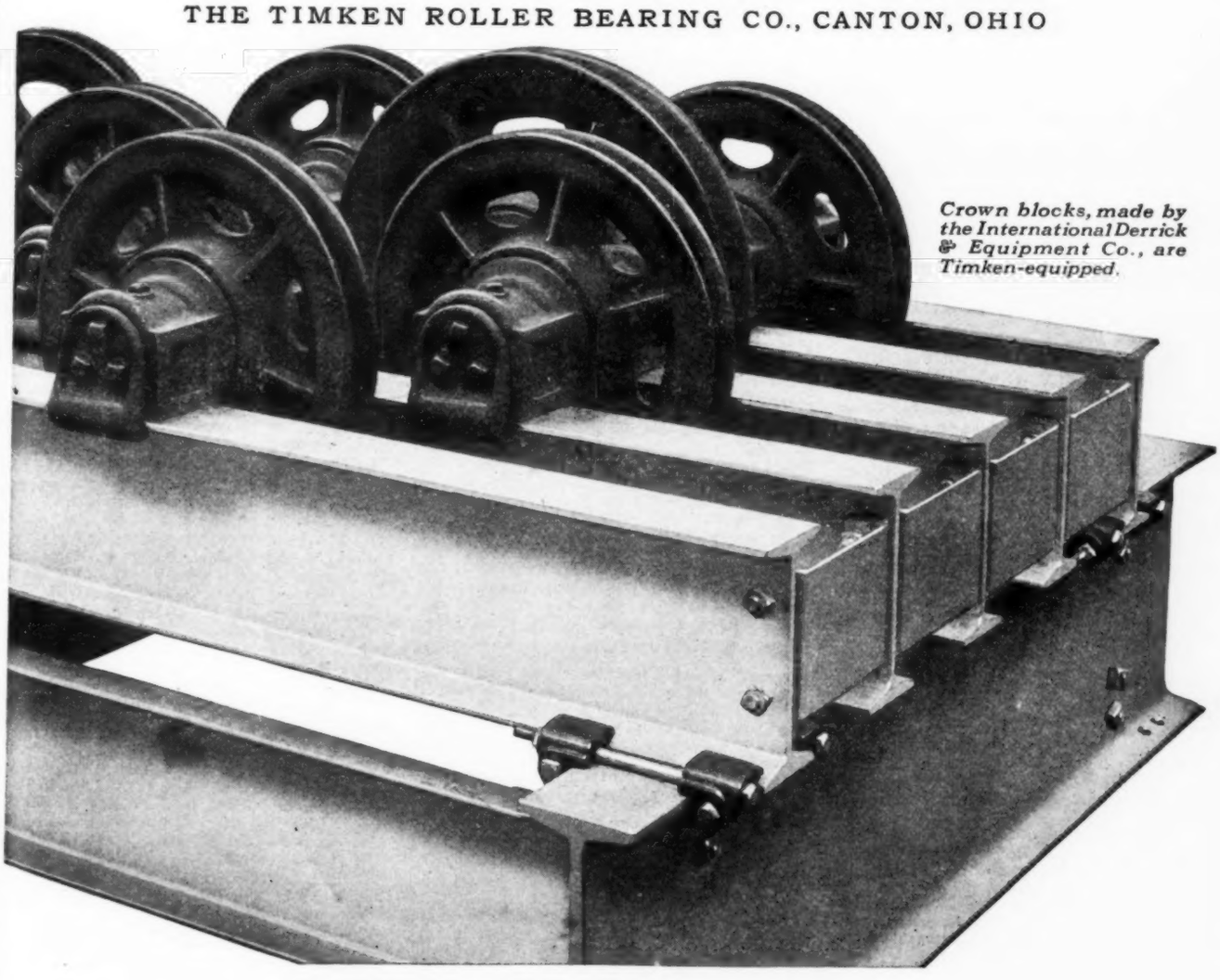

Crown blocks, made by the International Derrick & Equipment Co., are Timken-equipped.

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PERMITS GRANTED FOR NEW WELLS

WEEKLY COMPARISON OF NEW WELLS

Following is a condensed table giving a comparison of permits or locations made for new wells during the past year in Kansas, Oklahoma, Arkansas, Louisiana, Texas, California and the Mountain States:

	Week Ending Oct. 21	Previous Week	Total This Month	Total This Year	This Week Last Year	This Month 1926	Total Same Date 1926	Year Total 1926
Arkansas	5	3	14	290	10	37	984	910
California	..	16	32	1,011	30	94	1,328	1,293
Louisiana	9	16	33	590	30	67	1,229	1,318
Kansas	13	8	29	781	22	69	1,650	1,745
Oklahoma	55	48	131	3,221	93	244	4,464	5,165
Texas	154	93	356	7,525	291	774	11,044	12,158
Mountain States	..	24	24	386	11	43	671	...
Total	236	208	619	13,804	492	1,333	20,850	*22,589

*Does not include Mountain States.

ARKANSAS

COLUMBIA COUNTY — The Texas Co., Alexander 1, 8-17-19, 200 ft s and 200 ft e of nw c se sw.

NEVADA COUNTY—J. J. O'Brien, Haynie 2, 6-14-20, 660 ft s and 200 ft e of nw c sw sw.

UNION COUNTY — Ganther et al, McCough 1, 16-17-13, sw c sw ne. Garrett Modisette Drlg Co., Gregory 1, 10-17-14, 200 ft n and 200 ft w of se c ne se. Ohio Oil Co., Crain 3, 1-17-14, 330 ft s and 330 ft w of ne c nw se.

LOUISIANA

BOSSIER PARISH—Woodley & Collins & Atlantic Oil Prod. Co., Shreveport, L. & A. Oil Co. 3, 15-23n-12w, 660 ft s and 660 ft e of center.

CALCASIEU PARISH—Plummer Oil Co., Beaumont, Texas, Lyons 1, 28-9s-11w, 380 ft s and 802 ft w of ne c.

CATAHOULA PARISH—Standard, Shreveport, Tensas Delta Land Co. 1, 23-8n-5e, 1285 ft s and 3960 ft w of ne c.

IBERVILLE PARISH—Roxana Pet. Corp., Houston, Texas, A. Wilbert 1, 1-11s-12e, 650 ft from s line and 150 ft from w line, Sec. 1. Shreveport, L. & A. Oil Co. 41, 5-7n-2e, 300 ft port,ft from s l and 150 ft from w l sec 1.

LA SALLE PARISH — Tunica Pet. Co., s and 300 ft e of nw c ne nw.

RICHLAND PARISH — Moody-Seagraves Houston, McClanahan 1, 36-16n-5e, 2200 ft s and 680 ft w of ne c.

SABINE PARISH — J. W. Moffitt, et al, Shreveport, O. F. Moore 3, 5-9n-12w, 330 ft s and 330 ft w of ne c nw nw.
Co., Inc., Houma, Southdown 3, 103-17s-17e, n

TERREBONNE PARISH — Southern Gas 77° 15 ft w 4016.1 ft from ne c.

WEBSTER PARISH — Magnolia, Shreveport, Haynesville Merc. Co. 1, 1-22n-10w, 675 ft s and 660 ft w of ne c.

OKLAHOMA

CADDO COUNTY—Moran et al, Cutshall 1, ne se nw 5-5-9.

CREEK COUNTY—Continental Oil Co., Unallotted 1-A, nec 26-18-11. O. M. Irelan et al, Thomas 1, sw cse nw 13-17-10. Ted Roy Oil Co., Smiles 2, nwc ne sw 13-17-10. Thompson & Black, Wilson 5, nw se sw, 16-17-11. Turner & Turner, Penoke 5, nw c sw sw, 9-6-12. Independent O. & G. Co., Wolfe 4, ne sw ne, 18-14-10. Producers & Refiners Corp., Harjo 5, nw se ne, 18-14-10. Olean Pet. Co., Harjo 2A, se c nw ne sw, 13-17-8.

GARFIELD COUNTY—Marland, Garber 2, sw nw se, 19-23-3; Rhodes 1, nw ne nw, 30-23-3.

GRADY COUNTY — Oklahoma Nat. Gas Co., Glover 3, nw se ne 27-5-8. Hall & Briscoe, Nation 5, ne nw se 34-3-5.

GRANT COUNTY—Argo Oil Co., Swaggart 2, se c 15-27-3. Washoma & Roxana Pet. Corp., School Land 1, nw c sw 36-28-3.

HARPER COUNTY — A. F. Kopisch Oil Co., Selman 1, ne c se 24-27-21.

HUGHES COUNTY—Noble O. & G. Co., Wicket 1, se ne se 18-7-5.

JEFFERSON COUNTY—Denton, Lash & McCall, Trout 1, se ne se 18-7-5.

KAY COUNTY—Harris & Hahn, Hensel 3, ne c sw 15-29-1. Vernon O. & G. Co., Brockhouser 6, sw c nw sw se 17-29-1. Blackwell Oil & G . Co., Kumler 5, c sw se 9-27-1.

LINCOLN COUNTY—Empire G. & F. Co., Ward 2A, ne c 33-17-4. I. T. I. O., Lindsay 2, ne c 6-16-5.

LOGAN COUNTY — Champlin Ref. Co., Musgrove 1, se c sw 8-19-4.

MUSKOGEE COUNTY—A. A. Lang, McIntosh 1, sw c ne sw 20-15-18. Sunray Oil Corp., Hicks 1, ne c sw 5-14-19.

OKMULGEE COUNTY — Hutchinson & Becker, T. E. Doyle 4, sw c se nw 6-14-13. Sperry & Son, Lacey 6, cnl sw sw 7-14-13. Sharpe & Ellinger, Colbert 4, cwl ne nw 16-14-14.

OSAGE COUNTY—Okla. Nat. Gas Co. 776, se c nw ne, 33-21-12. Elliott & Smith 13, nw c se sw 20-21-12. Devonian Oil Co. No. 2, sw c ne ne 33-21-10. Geo. Tselos 3, nw sw ne, 11-24-11. Gault Brown 1, nw c ne, 7-24-8. Marland 3, ne cse 27-25-8. I. T. I. O. Co. 378, nw se ne 29-26-11. Kewanee O. & G. Co. 10, nw c se nw, 34-27-6. Peters Pet. Co., 8, se c nw 17-27-6. Winona Oil Co. 2, sw nw nw 17-29-11.

PONTOTOC COUNTY—Max Westheimer Wade 1, ne sw ne 19-5-8.

SEMINOLE COUNTY—T. B. Slick, Moore 1, sw ne sw 1-6-6. Phillips and W. B. Pine, Pattey 3, nw sw ne 35-8-6. I. T. I. O. and Phillips, Fore 1, se ne nw 35-8-6. I. T. I. O., Fay 8, nw ne sw, 13-8-6; Fay 7, ne se nw, 13-8-6. Magnolia Pet Co., Seay 10, nw c sw, 12-9-5. Jarvis & Holmes, Buchner 1, sw se se 6-9-8.

STEPHENS COUNTY — Dameron et al, Florence 1, ne nw se 11-3-6. Tuchy et al Edwards 1, ne nw ne 10-3-5. Magnolia, Martin 1, se sw ne 13-1-4.

TULSA COUNTY — Sand Springs Home, Gates 1, cnl se ne 4-19-11. Lockwood et al, Jones 1, nw c ne nw ne 15-19-11. Suppees et al, Smith 4, nw c sw, 5-17-13. S. W. Anthony, Sanderson 8, cnl nw 3-16-1.

WAGONER COUNTY—Shaffer, Dan 1, ne c sw nw 21-17-15.

KANSAS

COWLEY COUNTY—Roxana, Harness 1, sw c nw 19-31-3.

ELK COUNTY — Elmwood Oil Co. et al Woods 1, se c 15-30-10.

GREENWOOD COUNTY — Titus et al Derbyshire 1, se c ne se 17-22-11. Darby Pet. Co. Fankhouser 4, se c sw sw 24-22-12. Empire O. & R. Co., Ott 3, nw c 25-22-12; Ott d ne c nw nw 25-22-12. Marcus et al Freeman 1, ne c se sw 6-24-11. Christy et al Hoover 1, csl se ne 36-24-12. Pohlhamus et al May 1, se c sw 36-25-10. Stark et al Stanley 1, ne c 1-26-10. McGinnis et al Mills 1, nec sw sw 4-27-11.

SUMNER COUNTY—Noble et al Townlot 1, lot 11, City of Oxford 14-32-2. Phillips Pet. Co., Nevitt 1, se c nw 24-32-2.

TEXAS

ARCHER COUNTY—Grisham & Panhandle Oil & Ref. Co., Wichita Falls, Farmer 1, S 1, J. Poitevent sur, 150 ft from n and w lines. J. Poitevent sur, 150 ft from n and w lines. Panhandle Ref. o., Wichita Falls, Helm 1, B 2, J. W. Harris sur, nw cor. Koll-Te Oil Corp., Wichita Falls, White 4, S 41, B 12, Amer Trib sur, center. Unde wood Drilling Co., Wichita Falls, Marland 5, 1379 TE&L sur, 300 ft se of No. 3. Shappell Oil Co., Wichita Falls, Wilson 16, No. 4 SP Ry sur, 300 ft s of No. 4. Maer & Staniforth, Wichita Falls, Seay 1, J. W. Harris sur, 465 ft from e and 150 ft from s line. Consolidated Oil Co., Wichita Falls, Crawford 1, B 152, J. W. Harris sur, center

AUSTIN COUNTY—Humble, Houston, Kelieswski 1, C. Donoho sur, 500 ft from n and 1000 ft from e line.

BROWN COUNTY—Allsman & Bell, Cisco, Dabney 2, S 792 E. Brooks sur, 150 ft from n and w lines. Amerada Pet. Corp., Cisco, Gilbreath 2, SA&MG No. 4 sur, 150 from s and e lines; Moore 1, SA&MG No. 4 sur, 150 from e and e lines. Ditto Oil Interests, Fort Worth, Taylor 1, No. 618 T. M. Whittington sur, 155 ft from e and 165 ft from s line. Selby Oil & Gas Co., Tulsa, Ellis 18, S 3, SA&MG sur, 970 ft from n and 150 ft from e line; 19, 300 ft s of No. 18. J. K. Hughes Dev. Co., Mexia, Gilbreath 3, SA&MG sur, 300 ft n of No. 1. J. M. Harper, Parkersburg, W. Va., George 1, S 1, TTRy sur, 150 ft from n and 450 ft from e line. Golden Rod Oil Co., Dallas, Whidden 1, B 52, W. H. Irion sur; 2; 3. Phillips Pet. Co., Bartlesville, Okla., Newsom 8, B 4, SA&MG sur; 7, B 4, SA&MG sur. Aaron Cohen et al, Baltimore, Mr., Haynes 7, No. 789 J. Delgado sur, 385 ft sw of No. 5. Forest Pet. Corp., Wichita Falls, Moore 3, S 4, SA&MG sur, 150 ft from s and w lines. Kone Prod. Co., Cisco, Hickman 7, T. Benson sur, 300 ft n of No. 2. Humble Oil &Ref. Co., Cisco, Gilbreath 7, D. F. DeBoard sur, 301 ft s of No. 6; 6, 150 ft from n and e lines. J. H. Shell, Brownwood, McGaughey 1, No. 110 J. Cozens sur, 150 ft n of center of s line. Anchor Oil Corp., Coleman, Carter 1, S. 6, C. Messer sur, 249 varas from n and 500 varas from e line.

BORDEN COUNTY — Marland Oil Co., Fort Worth, McDavid 1, S 156 B 25, H&TC sur, center of sw¼.

BEXAR COUNTY—Schimmel Pet. Co., Ft. Worth, Koehler 11, No. 265 J. Wilson sur, 643 ft e of No. 10; 12, 602 ft s of No. 13; 13, 766 ft w of No. 8; 10, 554 ft n of No. 9.

BASTROP COUNTY — Culver, Noack & Lanning, Rockdale, Roemer 1, T. Christian sur, 150 ft from n and e lines.

CALLAHAN COUNTY—Moutrey Oil Co., Abilene, Hickman 8, S 149, BBB&C sur, 300 ft e of No. 7. Freeborn & Sargetn, Dallas, Dobban 10, 2995 TE&L sur, 450 ft from s and w lines. Jones & Keyes, Cisco, Wagley 2, 2998 TE&L sur, 450 ft from w and 460 ft from s line. M. C. McDonald, Putnam, Loban 26, 2995 TE&L sur, 275 ft sw of No. 24. W. D. Gillett, Abilene, Hickman 1, B 30, D&D Asy sur, 660 ft from s and e lines. Moutray Oil Co., Abilene, Flores 20, S 149, BBB&C sur, 400 ft e and 150 ft s of No. 18; 21, 150 ft from n and w lines. Reed & Groce, Baird, Kelton 1, S 130 BBB&C sur, 150 ft from s and e lines. Thomas & Gause, Abilene, Barr 1, S 21, BBB&C sur, center.

COLEMAN COUNTY—Ross Drilling Co., Dallas, Benke 1, S 664, S. Sprague sur, 150 ft from s and e lines. Gwinnup & White Eagle Oil & Ref. Co., Fort Worth, Casey 3, B 4, No. 657 H. Crocheran sur, 683 ft from s and 1025 ft from e line. Archie Shaw, Burkett, Burns 31, No. 168 A. Wickson sur, 961 ft from n and 1350 ft from e line; Watson 9, No. 163 Wm. Mason sur, 1050 ft from e and 800 ft from s line.

CROCKETT COUNTY—Osage Oil Corp., Tulsa, Halff 1, No. 70 B 1, I&GN sur, center. Van McPhail, Fort Worth, Half 1, S 70, 150 ft from n and w lines. F. H. Furham, Okmulgee, Clark 1, S 1, GC&SF sur, 250 ft w of center o fe line.

(Continued on page 96)

What One Oil Man Wrote to Another *about* VICTAULIC COUPLINGS

THE President of a large oil company wrote to the Vice-President of a great oil producing and refining company requesting his opinion of and experience with Victaulic Couplings. Here is the reply received:

1925

"OUR first experience was in 1921, when we tried out Victaulic Couplings on a 4" water line and we were impressed with the efficiency of this joint. Since that time we have continued and extended the use of this joint and at the present time, we have approximately two hundred miles of field line equipped with Victaulic Couplings. These lines vary from 4" diameter to 12" diameter and from two miles to twenty-five miles long.

"We have had these joints in operation for over four years and have found them very satisfactory indeed. We have used these joints on fresh water lines, salt water lines, hot salt water, gasoline, gas, crude oil—in fact for all purposes around a producing field and a refinery. *All our pipe is now ordered with Victaulic Couplings.*

"In the early part of this year we constructed a 12" gas line to pump residue gas from the compressors in the field to the refinery, a distance of eight miles, and Victaulic Couplings were used in the construction of this line and are giving good service. All our main 10" gathering system is equipped with Victaulic Couplings carrying a pressure of 200 lbs. and over, and we have had no trouble with these joints. One water line, which is a 10" line, twenty-five miles long and supplies water to the whole field, working under pressure of 400 lbs., is entirely equipped with Victaulic Couplings. It has been in operation eighteen months and is standing up well.

"Formerly we had to use a large number of expansion bends to allow for expansion and contraction caused by the large differences in temperature during the twenty-four hours, whereas, owing to the flexibility of the lines connected with Victaulic Couplings, we have cut out the use of expansion bends entirely.

"We have subjected our lines to very severe pressure tests and they failed to show any signs of leakage whatever."

1927

This company has adopted Victaulic Couplings as standard equipment and now has many hundreds of miles of pipe lines equipped with Victaulic Couplings.

For detailed information on Victaulic Couplings for all sizes and kinds of pipe and for all pressures, for typical installations and lists of uses and users, write for Bulletin No. 2.

VICTAULIC COMPANY OF AMERICA

26 Broadway New York, N. Y.

Western Distributors

SMITH SEPARATOR COMPANY

Tulsa Okla.

The all-purpose pipe coupling

VICTAULIC

REG. U.S. PAT. OFF.

Flexible, Leak-Proof Pipe Couplings

"For every joint on the line"

FOR CRUDE OIL, GAS, WATER, SEWAGE, COMPRESSED AIR, ETC.

Say you saw it in The OIL WEEKLY

WILDCATS FROM ALL SECTIONS

NORTHERN CALIFORNIA

Company, Well and Location — Initial Production Bbls. — Depth

FRESNO COUNTY

CLOVIS—Fresno-Madera Oil Co.'s 1, 18-12-21, sd 3825 ft.

KETTLEMAN HILLS—Superior Oil Co.'s 1, 26-21-17, dr 3900 ft.

NORTH COALINGA—Potter & Esplin's 1, 6-16-4, rig.

WARTHAM—Bald Mountain Drilling Co.'s 1, 20-12-13, sd 910 ft.

RAISIN CITY—Fresno-United Oil Co.'s 1, 23-15-18, sd 3960 ft.

KERN COUNTY

ANTELOPE PLAINS—W. H. Davis' 1, 13-26-17, abn 3245 ft.

BAKERSFIELD—Pacific Eastern Production Co.'s Union Avenue 1, plugged back to 4420 ft, very little oil.

ADOBE CANYON—California Petroleum Corp.'s Glide 1, 25-27-28, rigging rotary. Superior Oil Co.'s 1, 13-27-28, dr 900 ft.

BELRIDGE—Zurich Oil Co.'s 1, 18-28-22, changing to rotary 1325 ft.

BUTTONWILLOW — Milham Exploration Co.'s Kern 1A, plug 3250 ft, td 4660 ft, gas well; Salisbury 1, 7-29-24, sd 4150 ft. McAdams, et al's 1, 26-29-23, dr 1420 ft.

COMANCHE POINT—Kern 29 Oil Co.'s 1, 29-31-30, sd 2440 ft.

DELANO — Chansler-Canfield Midway's 1, 23-25-27, testing 6¼-in cas cmt 2163 ft, td 2300 ft. North American Consolidated Oil Co.'s 1, 5-25-25, dr 2770 ft.

DEVILS DEN—W. T. Garrett's 1, 30-25-19, rig. Marathon Oil Co.'s 1, 13-25-18, sd 4390 ft. Midway Northern Oil Co.'s 1, 25-25-18, co 2330 ft. R. H. Sayer's 1, 25-25-18, sd 1475 ft.

EDISON—George F. Getty's 1, 22-29-29, dr 3000 ft. General Petroleum Corp.'s 1, dr 3118 ft. Kerwin & Sealey's 1, 4-30-29, rig.

FRUITVALE — Pacific Eastern Production Co.'s 1, 21-29-27, cmt 15½-in cas 900 ft.

GREENFIELD—Mays & Valencia's 1, 31-30-28, rig.

GOULD HILLS — California-Kentucky Oil Co.'s 1, 8-29-21, oil showings 1620 ft. Bomke & Ball's 1, 12-29-20, dr 1300 ft. Mendocino Midway Oil Co.'s 1, 28-29-21, sd 2930 ft. Rhoads Oil Co.'s, will test 1485 ft. White Behr Oil Co.'s 1, 20-29-21, rig. L. E. Westrick's 1, 19-29-21, sd 1755 ft.

McKITTRICK—Abbott Pet. Co.'s 1, 2-30-21, sd 1940 ft. Electric Petroleum Co.'s 1, 34-30-22, sd 1620 ft. McKittrick Hills Oil Co.'s 1, 18-30-22, sd 3250 ft. Ozena Oil Co.'s 1, 27-29-21, oil showings 1728 ft.

MON BLUFF—Miocene Oil Co.'s 1, 34-27-28, rig. Shell's 1, 3-27-28, dr 2832 ft.

NORTH MIDWAY — Gore Oil Corp.'s 1, 34-30-22, sd 1350 ft.

SHALE HILLS — Huntington-Hawthorne's 1, 35-26-19, sd 600 ft.

SUNSET—Fresno-Sunmaid Oil Co.'s 1, 16-11-24, sd 4200 ft. Raleigh Oil Co.'s 1, 8-11-23, oil sand 2611 ft, will test.

TEMBLOR—Fortuna Oil Co.'s 1, 28-32-23, sd 500 ft.

TEHACHAPI—C. R. Asmussen's 1, 23-11-11, sd 1510 ft. Crusaders Oil Co.'s 1, 21-10-10, testing 6¼-in cas 2254 ft, td 2367 ft. John B. Harding's 1, 5-10-10, sd 1050 ft.

KINGS COUNTY

KETTLEMAN HILLS—Associated's Smith 1, 12-23-18, sd 2043 ft. Bolsa Chica Oil Co.'s 1, 30-23-19, sd 3500 ft. General Petroleum Corp.'s 1, 4-24-19, sdtr 6-in dr pipe 3800 ft; 1, 22-26-18, dr 4885 ft. Milham Exploration Co.'s 1, 2-22-17, dr 4989 ft. South Coalinga Oil Co.'s 1, 35-24-19, sd 2860 ft.

SANTA BARBARA COUNTY

BUELLTON—F. & W. Buttram's 1, rigging up.

GOLETA—Barnsdall Oil Co.'s Edwards 2, 36-4-30, lcn.

SANTA BARBARA — Henry R. Dabney's Wright 1, sd 135 ft. Channell Oil & Dev. Co.'s 1, dr 5660 ft. Hollywood Oil Corp.'s 1, sd 1300 ft.

Company, Well and Location — Initial Production Bbls. — Depth

SANTA YNEZ—San Marcos Oil Synd.'s 1, dr 2400 ft.

SUMMERLAND — Summerland Oil Co.'s Becker 1, 8¼-in cas cmt 3009 ft, td 3029 ft.

VENTURA COUNTY

CAMARILLO—Standard's Camarillo 1, dr pipe in hole, td 5590 ft.

FILLMORE—Sespe Oil Co.'s Smith 2, sd sd 4003 ft.

HOPPER CANYON — Hopper Canyon Oil Co.'s 1, sd 5005 ft.

MOORPARK—E. A. Parkford's Lloyd 1, sr 3860 ft. Shell's Berylwood 1, dr 5561 ft.

RINCON — Chanslor-Canfield Midway Oil Co.'s Hobson 1A, failed to produce, td 7000 ft; Hobson 1B, dr 5696 ft. Pan-American Oil Co.'s State 1, 13⅜-in cas cmt 2789 ft, td 3225 ft, oil sand near bottom.

SOUTH MOUNTAIN—Ring Pet. Corp.'s 1, 6¼-in cas cmt on bottom, td 3952 ft.

SULPHUR MOUNTAIN—Geiss & Bradford's 1, 21-4-22, testing for production 1997 ft.

SQUAW FLATS—Border Oil Co.'s 1, sd 675 ft.

TIMBER CANYON — San Pedro & Point Fermin Synd.'s 1, 13-4-21, dr 330 ft.

VENTURA — Associated's Dabney-Lloyd 1, oil showings 6450 ft. Star Petroleum Corp.'s 1, may skid rig, td 5340 ft.

MISCELLANEOUS

COLUSA COUNTY—Continental Oil Co.'s 1, 31-18-4, sdtr 10-in cas 2374 ft, td 3870 ft. Numa Oil Co.'s 1, 19-15-5, rig. Prize Oil Co.'s 1, 17-4-1, sd 845 ft.

SAN MATEO COUNTY—Shell's Cowell 1, 8-6-5, dr 4834 ft. Morris Schwartz's 1, 19-9-4, rig.

SONOMA COUNTY — Shell's Murphy 1, 8-5-7, dr 6363 ft; Murphy 2, 8-5-7, dr 1940 ft.

TULARE COUNTY—Birch Oil Co.'s 1, 13-21-26, co 2040 ft. Ducor Drilling Co.'s 1, 27-23-27, plugged to 3900 ft, td 4160 ft. Federal Exploration Co.'s 1, 15-22-24, cmt plug 5336 ft, td 5460 ft. Josephine E. Neame's 1, 24-17-24, sd 2025 ft.

SOUTHERN CALIFORNIA

BOYLE HEIGHTS—Haskell M. Greene's P. A. S. F. 1, 6¼-in cas cmt 2400 ft, td 3995 ft.

CLAREMONT—Claremont Oil & Gas Co.'s 1, sd 1130 ft.

DAVIDSON CITY—California Well Drilling Co.'s Del Amo 1, recmt 6¼-in cas 6511 ft.

DOMINGUEZ — Dominguez Extension Oil Co.'s R .B. 1, sd 5510 ft.

EL SEGUNDO—Rider Synd.'s El Segundo 1, sd 2300 ft. Southern California Drilling Co.'s Matteson 1, sd 4865 ft.

FAIRVIEW — Petroleum Securities Co.'s Fairview 1, dr 265 ft.

GARDENA—Circle Oil & Gas Co.'s Pomeroy 1, sd 4130 ft.

HAWTHORNE—San Clemente Oil Co.'s 1, oil sand 5240 ft, 8¼-in cas cmt 5175 ft. James O'Donnell's 1, dr 4717 ft.

HUNTINGTON BEACH — J. A. Brower's Huntington 1, dr 3808 ft. E. J. Miley's Calnan 1, dr hard gray sand 4975 ft. Leo Stein's Huntington 1, dr 3350 ft.

INGLEWOOD—Alenson & Co.'s 1, sd 3500 ft. Hu st & Compton's 1, sp.

LANCASTER—John B. Harding's La Loma 1, sd 702 ft.

MAYWOOD — Magnolia Petroleum Synd.'s 1, sd 4450 ft, redr to 2700 ft.

MONTEREY PARK — Monterey Park Pet. Co.'s Browning 1, dr 2270 ft.

MONTEBELLO — Rotary Air Drill Co.'s Germain 1, sd 1400 ft.

NEWHALL—W. W. Stabler's Castaic 1, sd 3408 ft. Thomason-McCoy's S. F. Canyon 1, sd 1610 ft.

OLIVE — Standard Oil Co.'s C. B. 1, dr 4260 ft.

ORANGE—Chas. A. Son's Pingerton 1, dr 2888 ft.

PLACENTIA—Shell's Allec 1, dr 4420 ft.

PUENTE HILLS—Anchor Petroleum Co.'s Hudson 1, dr 1967 ft.

Company, Well and Location — Initial Production Bbls. — Depth

POTRERO—Associated's Cypress 1, flowing 500 bbls from 4717 ft.

SAN FERNANDO — Shell's Mission 1, sr 4370 ft. Joseph Hummell's Tehunga 1, dr 165 ft.

SAN JOSE HILLS — Bardeen Oil Co.'s Didier 3, sd 2255 ft. B. & B. Oil Co.'s Amar 1, sd 4380 ft, plug 2600 ft.

SAN JUAN CAPISTRANO—O. K. Carr's Forster 1, oil streaks 3960 ft, setting 8¼-in cas 3974 ft.

TELEGRAPH CANYON—Quadra Petroleum Co.'s M. J. M. 1, sd 4210 ft.

WATTS—Southwest Petroleum Corp.'s Ramsaur 1, dr 4050 ft.

WATSON — White-Behr Consolidated Oil Co.'s Y. L. W. 1, dr 4211 ft. Petroleum Securities' Kraemer 1, dr 3012 ft.

MISCELLANEOUS

RIVERSIDE COUNTY—L. R. Clark's Cabazon 2, dr 366 ft. Corona Oil & Gas Co.'s 1, sd 1550 ft. Homet Petroleum Co.'s 1, dr 1415 ft. Trabuco Oil Co.'s 1, dr 2484 ft. Spindletop Oil Synd.'s 1, dr 2940 ft.

SAN BERNARDINO COUNTY—Como Oil Co.'s Cajon 1, sd 1460 ft. Colton Terrace Oil Co.'s Colton 1, dr 1475 ft. Del Rosa Oil Co.'s 1, fsh 915 ft. Hesperia Oil & Gas Co.'s 1A, sd 3312 ft. Western Pacific Oil Co.'s 1, sd 3005 ft.

SAN DIEGO COUNTY—Cardiff Oil Corp.'s Turner 1, sd 2805 ft. Oceanside Oil Co.'s Dunn 1, sd 3210 ft. Southern Oil & Gas Co.'s Randall 1, sd 2450 ft. Torrey Pines Oil Co.'s 1, sd 480 ft.

MOUNTAIN STATES

WYOMING

BIG HORN COUNTY—Agate Oil Co., ne 13-51-93, dr. Utah Southern's 3, 29-56n-97w, ur 8¼-in at 2400 ft, dr ahead. Wisconsin-Himes' 9-34n-94w, moving tools to clean out and deepen.

CARBON COUNTY — Graybeal Synd., 16-28-91, coring with rotary, td 4010 ft. Pacific-American Oil Co., 31-25-91w, location.

CONVERSE COUNTY—A. A. Tylee, ne 8-32-72, rig. Criterion Oil Co., Irvine 1, 5-31-70, dr 3410 ft. John Ackard's McKinley 1, 21-31-69, dr below 2750 ft.

FREMONT COUNTY—Producers & Refiners, Muskrat 1, 34-34-92, run 15½-in at 675 ft. Texas Prod. Co., Alkali Butte 1, 1-33-92, spd and sd. Zola Oil Co.'s Crooks Gap 1, twp 27, range 92, dr 3165 ft. Iowa-Wyoming Inv. Co., 30-1s-2e, testing at 1400-1465 ft.

JOHNSON COUNTY — Fairway Oil Co., Crazy Woman 1, 7-47-82, ur to bottom at 2025 ft. Tarrant Synd.'s 2, 17-46n-82w, ur at 3615 ft. Murphy & Grove, 10-41n-80w, dr 500 ft.

NATRONA COUNTY—North Casper Creek O. & G., se 1-36-82, dr 1200 ft. Combs Inv., Co., 12-39-78, moving in material.

NIOBRARA COUNTY — Penn-West. Pet. Co., 13-35n-62w, resuming at 800 ft. Hollingsworth Bros., 17-39n-60w, dr up casing shot off in an attempt to sdtr lost tools.

PARK COUNTY—Platte River Drill Synd., se 12-26-67, dr. Union of Calif.'s Taylor 1, 22-47-101, dr 1470 ft. Fred G. Ostland's Hoodoo Ranch 1, 53-51-102, dr 1190 ft. Honolulu Oil Corp.'s Four Bear 1, 29-48-106, dr 1213 ft. Ralph Arnold & Charls Mau, Frannie structure, delayed in resuming at 1800 ft, waiting for electricity from the Montana Power Co. line. N. F. Clark, 11-49-101, sd for winter at 700 ft.

PLATTE COUNTY—Walter Adams, Trustee, sec 13-25-66, resuming at 1650 ft, 6¼-in casing following.

SWEETWATER COUNTY — Boar's Tusk Oil Co., 16-23-104, dr below 1000 ft. Prairie O & G. Co.'s Tucker 1, 18-13-99, straightening hole at 340 ft. P. & R. Corp.-Marland Oil Co. of Colorado, 26-20-104, rigged.

WASHAKIE COUNTY — P. & R. Corp., Tensleep 1, 13-46-89, recmt at 1925 ft.

WESTON COUNTY — Allen Oil Co. & Olympic Ref. Co., ne 15-44-64, rigging up.

UINTA COUNTY—Uinta Oil & Dev. Co., in town of Evanston, dr 750 ft.

. . . . . *If* you are interested in wildcat drilling, you will also be interested in the HALLIBURTON Sand Tester. It makes wildcat drilling safe for rotary tools.

Write for details.

ERLE P. HALLIBURTON
Duncan, Okla.

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Without obligation, please send me full details of the Halliburton Sand Tester, together with prices.

Name.....
Street.....
City.....
State.....

MONTANA

BEAVERHEAD COUNTY — Crowley Oil Co.'s Crowley Dome 1, ne 2-7s-10w, rig.

BLAINE COUNTY — Cassady-Nichols, ne 29-34-18e, lcn.

CARBON COUNTY—Ohio Oil Co.'s Northern Pacific 1, 11-7s-21e, ur at 2390 ft. Book et al's Moore 1, 13-17-23, bottomed at 850 ft, waiting for supplies.

FERGUS COUNTY—Winnett Drilling Co., Winnett 1, sw 6-14n-27e, rig up. Rowland et al's Black Butte 1, 13-17-23e, dr below 1000 ft.

FLATHEAD COUNTY—Flathead Pet. Co.'s Reservation 1, sw 35-23-22w, rig.

GLACIER COUNTY—Rim Rock Oil Co., 29-35-5w, rig.

HILL COUNTY—A. H. McFarland et al, sw 15-30-13e, dr 1000 ft. Gad-Hamilton et al's Goldstone 1, s w25-36-9e, rig. Equitable Oil Co.'s Perkins 1, 34-33-12e, dr 3100 ft.

LIBERTY COUNTY — Chester Oils, Inc., Laird 1, 31-27n-6e, dr at 1100 ft. Patterson et al, Elmer Brown 1, 19-37n-4e, ¶13 at 1658 ft. Sunburst O. & R. Co.'s Disotell 1, 10-37n-5e, dr ¶14½ gas 2250 ft.

MUSSELSHELL COUNTY — Harte et al, ne 24-7-24e, lcn. McElwain Oil Dev. Assn.'s 1, 2-11-22e, rig up.

RICHLAND COUNTY—Community Drlg. Co.'s Pioneer 1, rigging to drill deeper from 2600 ft.

TETON COUNTY—Drilling et al, ne 9-25-1e, dr at 3485 ft. Fidelity Oil Co.'s 1, 15-25-1e, dr 300 ft.

ROOSEVELT COUNTY—Pioneer O. & G. Co. 1, se 35-27-51e, sd at 1590 ft.

PONDERA COUNTY—Mutual Drlg. Co., 5-27-3w, dr 100 ft. S. C. Ferdig et al, 1, 8-27-4w, rig up.

PHILLIPS COUNTY—Big Dome Oil Co.'s Bloomberg 1, ne ne 1-32-32e, rig.

SWEETGRASS COUNTY—Shoshone Cons. Oil Co., nw 23-2n-15e, dr.

TETON COUNTY—J. W. Elliott et al, 1-25-1w, abn 1710 ft. Homestate Explo. Corp., Acme 1, 20-25-1w, dr 1300 ft. S. C. Ferdig et al, 12-25-1w, dr 1300 ft. California Pet. Corp.'s Johnson 1, 20-26n-1e, dr 1200 ft.

TOOLE COUNTY — Kevin-Flathead Oil Co.'s Toole 1, ne 27-36n-23, sd at 2200 ft. Zenith-McDonald, Lowey 1, 25-36n-1w, dr 2000 ft. Montana-Pacific Oil Co., Clarks 1, se 20-37-1e, abn 2250 ft. Sunburst O. & G. Co.'s Grandview 1, 10-34n-3e, rig. Commonwealth Pet. Co.'s Benjamin 1, 22-31-2e, dr at 1500 ft. Madeline Oil Co.'s Swanson 1, 33-35-4w, dr 200 ft.

YELLOWSTONE COUNTY — Neudigate Oil Co.'s Happy Hollow 1, nw nw 25-1s-24e, rig up.

COLORADO

BOULDER COUNTY—Left Hand Oil Co.'s Prechtl, 34-3n-70, recmt 4¾-in at 1954 ft. Essok Oil Co.'s Martin 1, 5-1s-70, dr 4380 ft. Repollo Oil Co.'s Nichols 1, 32-1n-70w, dr 1200 ft.

FREMONT COUNTY—Fremont Leasing & Holuing Co.'s 1, 2-19-70, fsh. Columbia Oil Co.'s Sheridan 1, 20-18-70, sd at 2240 ft.

LAS ANIMAS COUNTY — Parker Club, Inc.'s Adams 1, 32-34-55, dr below 3600 ft. Foley & Goldsworthy's Government 1, 11-30-60, dr at 1950 ft.

LA PLATA COUNTY—Klem Synd.'s Ferguson 1, 12-34n-7w, standing at 2000 ft. Collins et al's Aspaas 1, 10-34n-11w, dr at 700 ft.

LOGAN COUNTY—Northeastern Colo. Oil Co.'s State 1, 36-8-55, casing set at 5010 ft.

MOFFATT COUNTY—Ohio Oil Co.'s Kuykendall 1, 22-21n-11w, cmt 14¼-in at 1536 ft. Reitre-Foster Oil Co.'s State 1, 16-12-100, dr at 1520 ft.

MONTEZUMA COUNTY—Coon & Cotton's Hall 1, 9-35n-13w, dr 560 ft.

RIO BLANCO—Texas Prod. Co.'s Freeman 1, 27-3-94, dr out cmt at 4945 ft.

ROUTT COUNTY—Great West. Oil Co.'s State 1, 17-6n-86w, sp 150 ft.

SAGUACHE COUNTY — Cook, Weber et al's State 1, 27-41n-10e, hole partly cleared, td 4300 ft.

WELD COUNTY—Platte Valley Pet. Co.'s Patterson 1, 24-6-61, dr 3310 ft. Platte Valley Pet. Co.'s 5-8-56, sd at 250 ft.

NEW MEXICO

CURRY COUNTY — Hasson Pet. Co.'s Laird 1, 22-8-36, spd and sd. Frio Oil Co.'s Saunders 2, 11-5n-35, sd at 1240 ft. Clovis O. & G. Co.'s Hoskinson 1, 21-3n-36, dr below 3165 ft.

CHAVES COUNTY — Gibson Oil Corp., Forsyth 1, 8-11-23, sd at 675 ft. Buffalo-Roswell 1, 24-11-27, sd at 4260 ft. Texas Prod. Co., Wilson 1, 29-17-18, dr at 4765 ft. Twin Mounds Drlg. Co.'s Fahrlander 2, 11-6-27, sd at 80 ft. Arena Oil Co.'s 1, 18-13s-31e, fsh tools at 750 ft. McQuigg Bros.' Neis 1, 7-5s-29e, rigged.

DEBACA COUNTY—Trigg Synd.'s 1, 27-4n-22, sd at 300 ft. Barber-Woods Oil Co., Woods 1, 6-4-20, sd at 390 ft.

GUADALUPE COUNTY — Hanchett Oil Co., Rutherford 1, 24-8-24, dr below 3000 ft. Union Pet. Co.'s McMullen 1, 24-5n-16, sd at 235 ft to straighten titles. Navajo Oil Co.'s Goard 1, 10-3-7, dr at 2550 ft.

LEA COUNTY—Midwest Ref. Co.'s Hobbs 1, 9-19s-38e, sp.

McKINLEY COUNTY—Smart & Reid, 7-17-9, rig. Inland Oil Corp.'s 22-18-10, ur fast in hole at 815 ft. S. Dysart 1, 21-14-9, dr below 1540 ft. Continental Oil Co.'s Carrica 1, sw 9-17n-7w, dr 1700 ft. Jenkins Oil Co.'s 1-16n-9w, dr 400 ft. Williams et al's 230-18n-8w, dr below 800 ft. Ohio Oil Co.'s Nightingale 1, 25-17-6w, dr 1505 ft. Reliance Oil Co.'s Hanchett 1, 16-17-9, ur, td 805 ft. Producers & Refiners Corp.'s 1, 12-17-9, rig.

QUAY COUNTY—Gibson Oil Corp.'s 1, 25-8-32, standing at 3502 ft. Ohio Oil Co.'s Jordan Ridge 1, 24-7-29, dr at 3955 ft.

TORRANCE COUNTY—San Juan O. & G. Co., Minerman 1, 32-7-10, sd at 2650 ft. San Juan O. & G. Co.'s Randall 2, 20-6-19, dr below 4730 ft. Duran Dome Oil Co., Duran Dome 1, 31-2-14, fsh lost tools at 1400 ft. F. G. Wilson, Trustee, Pace 1, 12-6n-27, dr 2025 ft.

SAN JUAN COUNTY — Continental Oil Co.'s Munoz 17, 2-29-19, redr 3500 ft. Portage O. & G. Co.'s 3, 25-31-13, dr 1185 ft. Portage O. & G. Co.'s Glade 1, 24-30-13, cas off water at 1260 ft. Kansas-Colo. Oil Co.'s Atteberry 1, 24-31-11, wtg for dr line at 1860 ft. T. C. N. Oil Co.'s Lanier 1, 9-29-11, mvg equipt. Huntington Park Oil Co.'s 2, 29-30-9, dr at 4020 ft. R. M. Smith, Abrams 2, 23-29-11, dr below 600 ft. Huerfano Oil Co.'s Wiltbank 1, 25-29-11, standing. Astec Oil Dev. Co.'s Finch 1, 15-29-11, repairing equipt, td 650 ft.

SOCORRO COUNTY—Abo Oil Co. 1A 14-3s-6e, set 12½-in at 600 ft and sd to reorganize.

VALENCIA COUNTY — Acme Oil Co., New Mex.-Ariz. Land Co., 26-6-3, td 1962 ft, bldg standard rig. Stone et al's Perrin & Swisher 2, 25-7-2, fsh pipe at 1967 ft.

UNION COUNTY — Sun State Pet. Co.'s Paso Monte 1, 14-24-30, sd at 2977 ft. Operations to be resumed by Blankenship Pet. Co.

LOUISIANA

Company, Well and Location	Initial Production Bbls.	Depth
CADDO PARISH—		
Golden Rod Oil Co.'s Hampton A-1, 16-21-15	*	4050
LA SALLE PARISH—		
Shreveport Oil Corp.'s Morrow 1, 26-10-1e	*	1600
OUACHITA PARISH—		
J. D. Gould's Brayling 1, 11-15-2e	*	3010
SABINE PARISH—		
Tate et al's Cook Land Co. 1, 23-10-11	*	3296

BIENVILLE PARISH—E. J. Forrest's Perritt 1, 11-17-6, dr 2170 ft. Lake Bistineau Gas Co.'s State 1, 16-16-10, set 10-in at 200 ft. Louisiana Pet. Co.'s Hayes 1, 18-16-5, dk.

BOSSIER PARISH—Bahan & Davis' Dodson 1, 15-23-12, dr 500 ft. Bethany O. & G. Co.'s Dodson 2, 16-231-2, set 6-in at 3080 ft. R. L. Crook's Larkin 7, 14-19-11, testing 420 ft. Doern et al's Bollinger 1, 9-22-11, dr 2300 ft. H. S. Goodwin, Tr.'s Curtis 1, 2-16-13, dr 1220 ft. Hamiter et al's Hamiter 1, 10-23-13, rig. Humble's B. & W. 30, 15-19-11, r 4219 ft. Jensen et al's Hale 1, 17-18-11, arr to test 1244 ft. Magnolia's Dodson 1, 16-23-12, arr to bail 3082 ft. Z. Robertson 1, 23-23-12, dr 2485 ft; G. Roberson 1, 26-23-12, lcn. J. S. McCullough, Tr.'s Hodges 3, 25-16-12, wosr 1558 ft. Northwest La. Gas Co.'s Mays 1, 22-23-12, dr 2715 ft. O'Brien Bro.'s Dodson 1, 22-23-12, rig. R. O. Roy's Werner 1, 7-17-11, dk. Sligo Synd.'s Smith 2, 24-17-12, set 12½-in at 833 ft. Sales & Walker's Bollinger 3, 30-23-11, testing 3081 ft. The Texas Co.'s Wilkinson 1, 26-23-12, testing 2701 ft. Triangle Drlg. Co.'s Sentell & Dickinson 1, 3-20-13, dr 2000 ft. Walker et al's Antrim 1, 28-23-12, sd 1360 ft. Woodley & Collins Lincoln 1, 21-16-10, dr 1900 ft.

CADDO PARISH—Arkansas Fuel Oil Co.'s Lane 2, 13-21-15, dr 3679 ft; Huckaby 1, 14-21-15, wosr 3906 ft; Bashara 2, 23-21-15, testing 3635 ft. Belchic & Lasky's Sarp 2, 19-18-16, set 6-in at 891 ft. Bethany O. & G. Co.'s Offenhauser 1, 1-20-16, wosr 2260 ft. J. R. Bahan's Abney Est. 1, 31-17-16, dr 900 ft. J. O. A. Carper, Tr.'s Hammock 1, 27-18-16, dr 790 ft. Dixie Oil Co.'s C. M. L. 9, 23-21-15, dr 3461 ft; Clark 9, 14-21-15, dk; Files Mabry B-6, 14-21-15, set 6¼-in at 3695 ft; Slattery 10, 27-21-15, dr 4117 ft; Noel A-2, 13-21-15, dr 3965 ft; Robertshaw 89, 14-21-15, blg 3780ft; Robertshaw 90, 14-21-15, set 8-in at 2588 ft; Robertshaw 91, 14-21-15, dk; Huckaby 4, 11-21-15, dk. W. W. Dodson's Rives 6, 5-20-16, wosr 1866 ft. Double I Oil Co.'s Watkins & Lane 7, 27-21-15, dk. Falcon Drlg. Co.'s Schmidt 1, 27-20-15, wosr 2292 ft. T. D. Gary et al's Hart 1, 29-21-16, set 4½-in at 2228 ft. Greenwood pro.' Co.'s McCutcheon 1, 15-17-16, set 6-in at 2536 ft; Agurs 3, 6-16-16, dr 603 ft. Gulf's Herndon 11, 15-21-15, lcn. Haynes Bro.'s Murray 2, 14-21-15, dr 3870 ft; Spell 2, 15-21-15, sd 3093 ft. Magnolia's Bell 2, 4-17-16, lcn; J. W. Furrh 1, 28-18-16, arr to cement off bottom 1765 ft; J. Furrh 1, 32-18-16, set 13⅜-in at 212 ft; Dillon 18, 24-21-15, dk; Dillon 21, 23-21-15, tested gas at 2607 ft; Robertshaw 22, 23-21-15, dk; Hampton A-8, 15-21-15, dr 2190 ft. Ohio Oil Co.'s Aaron B. Land Co. 1, 32-23-16, sd 1553 ft; Plum 1, 32-23-16, sd 1619 ft; Smith 25, 12-21-15, sd 4750 ft; Thompson 1, 32-23-16, lcn. Palmer Corp.'s Sellington 1, 17-21-14, arr to test 3098 ft. Pittsburgh O. & D. Co.'s Herndon 1, 15-21-15, sd 3946 ft. D. C. Richardson's Youree-Randolph 5, 13-20-15, wosr 2266 ft. Shreveport Oil Corp.'s State 1, 23-21-16, dk; State 2, 27-21-15, sd 2400 ft. Simplex Oil Co.'s Thomas et al 3, 15-20-15, wosr 2353 ft. Standard's Hart 15, 34-21-16, wosr 1832 ft; Helpman 53, 16-21-16, rig. Superior Oil Co.'s Youree 6, 26-20-15, wosr 2301 ft. The Texas Co.'s C. M. L. 47, 23-21-15, sd 3657 ft; C. M. L. 49, 23-21-15, dr 3625 ft; C. M. L. 50, 23-21-15, set 8⅛-in at 3573 ft; C. M. L. 51, 23-21-15, sd 2580 ft; Mabry 10, 15-21-15, sd 3690 ft; Herndon 7, 14-21-15, dk; Herndon 8, 14-21-15, set 8¼-in at 3580 ft; Herold 9, 14-21-15, blg 3640 ft; Herold 10, 14-21-15, sd 3570 ft; Raines 19, 15-21-15, sd 3868 ft; Noel B-14, 14-21-15, dr 2602 ft. Tubbs et al's Hines 1, 16-14-16, sd 1421 ft. Woodley Pet. Co.'s Knight B-3, 11-15-12, arr to deepen 3466 ft; Knight B-4, 2-15-12, dk. Woodley & Collins' McVey A-1, 23-19-14, rig.

CALDWELL PARISH — Grayson Oil Co.'s Crockett 1, 6-12-14, sd 2692 ft. Southern Crude Oil Purchasing Co.'s Caldwell L. & T. Co. 8, 5-13-5e, dr 1750 ft.

CATAHOULA PARISH — S. D. Hunter's Tensas Delta 3, 4-9n-8e, dr 2028 ft. Lochnager et al's Beazley 2, 26-9-6e, set 6-in at 3114 ft; McMillon 11, 29-8-6e, rig.

CLAIBORNE PARISH—El Dorado Chief Oil Co.'s Jones 1, 8-20-6e, lcn. Magnolia's Lee 1, 16-22-8, set 8⅛-in at 4090 ft.

DE SOTO PARISH—American Controlled Oil Co.'s Lanier 1, 7-11-11, set 10-in at 180 ft. J. H. Askew's Richardson 1, 25-13-11, dr 2482 ft. Chal Daniels et al's Frost Johnson 1, 1-11-16, sd 100 ft. Dixie's Jenkins 1, 9-12-11, dr 5617 ft. Hazlett-Simmons' Neely 2, 1-14-12, dr 500 ft. Magnolia's Logan 1, 17-10-12, blg 3195 ft. Reliance Drlg. Co.'s Jones 1, 8-11-14, sd 2815 ft. W. M. Sebastian's D. H. Sebastian 1, 11-10-13, sidetracking 3405 ft; Wolf 1, 3-10-13, lcn. The Texas Co.'s Sample C-15, 36-13-12, sd 2551 ft; Wemple A-6, 2-12-12, cleaning out 2429 ft; Brinkerhoff B-36, 30-12-10, sd 2502 ft. Wingfield et al's Haygood 1, 18-10-12, dr 1800 ft.

FRANKLIN PARISH — Barbour Oil Co.'s Baker 1, 3-15-7e, sd 2884 ft. T. H. Cowell's Moore 3, 12-11-6e, set 8¼-in at 710 ft.

GRANT PARISH—Holmes et al's Swope 2, 18-9-1e, lcn. L. C. Swope et al's Fee 3, plugging off bottom 1607 ft; Fee 5, 18-9e-1e, dk.

LA SALLE PARISH—Bickman & Freeman's Urania 10, 7-10-2e, rig. Elbert Pet. Co.'s Urania 5, 7-10-2e, set 6-in at 1506 ft. Montague Oil Co.'s Zenoria Lbr. Co. 6, 11-9-1e, wosr 1486 ft. Natural G. & F. Co.'s Urania M-12, 20-10-2e, coring 1848 ft. Tunica Pet. Co.'s L. & A. 39, 3-7-2e, dk. Wingfield et al's Gibson 2, 2-9-1e, sd 3073 ft.

MOREHOUSE PARISH—Cons. Carbon Co.'s Perry 1, 14-20-4e, lcn. Keisker et al's Bonita

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Lbr. Co. 1, 10-23-9e, dk. Nat. G. Prod. Co.'s Tensas Delta 9, 27-22-4e, dr 2200 ft; Tensas Delta 10, 22-27-4e, dk. The Texas Co.'s Sivley 1, 22-20-6e, dr 3136 ft. United Carbon Co.'s Atkins 1, 26-20-5e, dk.

NATCHITOCHES PARISH—Ohio Oil Co.'s L. & A. 2, 26-13-6w, fsh 3251 ft. Tate et al's Leopold 1, 4-10-10, lcn.

OUACHITA PARISH — Hatcher & Evans' Hatcher 6, 16-19-4e, set 8-in at 826 ft. Imperial O. & G. Co.'s Tubbs 2, 13-19-3e, dk. Industrial G. Co.'s Sullivan 2, 5-18-4e, set 6-in at 2148 ft; McGee 1, 3-18-4e, rig. Jordan Drlg. Co.'s Miller 1, 18-18-5e, lcn. La. Dev. Co.'s Fee 45, 20-20-5e, dk. Ouachita Nat. Gas Co.'s D'Arbonne 2-A, 34-19-3e, dr ft. Peerless Co.'s Moore 3, 49-20-4e, lcn.

RICHLAND PARISH—Gulf's Marshfield 3, 30-17-6e, set 6⅝-in at 2322 ft; Wayne L. & T. Co. 2, 23-16-5e, rig. Helm et al's Tensas 1, 10-14-5e, sd 22 ft. La. Pet. Co.'s Binion 1, 22-17-6e, sd 2474 ft. Moody & Seagraves' McCoy 2, 30-16-6e, dk; Jones 1, 15-18-7e, dr 2200 ft; McClanahan 1, 36-16-5e, lcn. Natural G. & F. Corp.'s Sortor 1, 20-16-6e, arr to deepen 2367 ft; Sortor B-2, 19-16-6e, lcn; Sortor B-3, 19-16-6e, lcn. Oliver et al's Hatch 1, 2-15-5e, sd 2316 ft. Standard Drlg. Co.'s H. L. Co. 1, 22-16-7e, dr 1750 ft. Tex-La. Carbon Co.'s Broughton 1, 1-15-6e, dr 2891 ft. Woodley Pet. Co.'s Hemler 1, 31-18-7e, sd 2246 ft.

SABINE PARISH—Arkansas F. Oil Co.'s Logan A-1, 23-10-12, dr 3776 ft; Logan 10, 32-10-12, sd 3980 ft; Logan 11, 33-10-12, dk; Moore 2, 32-10-12, arr to deepen 3214 ft. Emlet et al's Bowman Hicks 6, 8-7-12, sd 3710 ft; Bowman Hicks 7, 11-7-14, dr 3442 ft; Mansfield H. L. Co. 1, 15-7-14, sd 516 ft. Frazier et al's Harris 1, 29-10-12, fsh 3140 ft. Longoria et al's Burkett 1, 9-9-13, dk. Magnolia's Rembert 1, 32-10-12, wosr 3240 ft. Rembert 2, 32-10-12, dr 1890 ft; Hall 2, 33-10-12, dr 3176 ft. A. H. Tarver's Long Bell Lbr. Co. 1, 5-8-13, coring 3230 ft.

UNION PARISH—Camette et al's Tugwell 1, 21-22-1e, sd 2112 ft. Interstate Nat. G. Co.'s Parks 1, 32-20-3e, rig; Stephenson 1, 6-21-4e, lcn; Steele 1, 36-20-3e, dk. Southern Carbon Co.'s Harris 1, 20-20-4e, set 6-in at 2081 ft.

WEBSTER PARISH—Crusader Oil Producing Co.'s Hope 18, 24-21-10, wosr 2507 ft. S. A. Lane's Miles 1, 24-17-9, rig. Magnolia's Cox 3, 23-21-10, set 6⅝-in at 4301 ft; Aarnes Cox 3, 22-21-10, dk; Marshall 4, 21-21-10, blg 2578 ft; Marshall 5, 21-21-10, set 6⅝-in at 2526 ft; Wise 1, 30-23-9, set 10¾-in at 421 ft; Cole 1, 27-21-10, dr 2080 ft; D. G. Cox 1, 22-21-10, set 13⅜-in at 340 ft; Newsome 1, 32-23-9, lcn. Ohio Oil Co.'s Holloway 4, 23-21-10, dr 3597 ft. Shreveport-El Dorado Pipe Line Co.'s Gamble 1, 33-20-8, dr 3284 ft. Woodley Pet. Co.'s Cox B-1, 23-21-10, dr 4361 ft.

WINN PARISH—Ohio Oil Co.'s Rolen 1, 9-12-1w, sd 2149 ft; Edenborne 1, 31-10-4w, fsh 525 ft; Rolen Account 1, 5-12-1w, rig. H. M. Roark's Southern Mineral Co. 1, 19-11-3w, undrr casing 303 ft.

WEST CARROLL PARISH—Palmer Corp.'s Pioneer Cooperage Co. 1, 16-20-10e, sd 2710 ft. Phillips Pet. Co.'s Darnell 1, 32-20-9e, dr 2038 ft.

ARKANSAS

Company, Well and Location	Initial Production Bbls.	Depth
COLUMBIA COUNTY—		
Columbia Oil Synd.'s Whitehead 1, 14-19-23	*	2359
OUACHITA COUNTY—		
H. M. Harrell Tr.'s Camden C. & C. Co. 1, 12-12-18	*	2765

ASHLEY COUNTY—Glassell et al's Keller 1, 10-19-5, dr 2948 ft.

BRADLEY COUNTY—Johnson & McAdams' Southern Lbr. Co. 1, 12-12-12, sd 2204 ft.

CALHOUN COUNTY—Genther et al's Stout 1, 3-14-16, sd 1910 ft.

COLUMBIA COUNTY — Mitchell et al's Franks 1, 25-19-22, sd 150 ft. Mitchell & Bass' Bodcaw 2, 4-20-21, sd 2804 ft. Maier et al's Gantt 1, 15-17-22, dk. Scott-Phillips' Davis Dr. Co. 2, 6-18-20, sd 2145 ft. The Texas Co.'s Alexander 1, 8-17-19, dk. Wingfield et al's Bodcaw 1, 4-20-21, sd 2025 ft.

DREW COUNTY—McClintock's Ogle 1, 35-13-5, sd 2550 ft.

GRANT COUNTY—Jones et al's Meeks 1, 5-4-11, sd 1400 ft.

LAFAYETTE COUNTY—Ken-Saw Pet. Co.'s Red River Lbr. Co. 2, 5-20-24, sd 2840 ft.

LINCOLN COUNTY—Pine Prairie O. & G. Co.'s Carter 1, 33-10-6, 2176 ft.

LITTLE RIVER COUNTY—Grote et al's Allen 1, 2-13-31, sd 2941 ft.

MILLER COUNTY—E. B. Guess' M. & P. Bank 1, 30-15-26, tested sw at 2929 ft. Lenze et al's Mann 1, 22-15-26, dr 2465 ft.

NEVADA COUNTY—Aines & Zingg's Womack 1, 10-14-21, wosr 1215 ft. Burnham et al's Kinney 1, 9-14-21, wosr 1262 ft. Fruen et al's Rhodes 1, 22-12-21, sd 1515 ft. Humble's Fairchild 2, 6-14-20, set 6⅝-in at 1183 ft; McDonald et al's Pell 1, 9-15-22, dr 980 ft. J. J. O'Brien's Haynie 2, 6-14-20, dk; Haynie B-5, 1-14-21, arr to plug off bottom 1163 ft; Moss A-5, 1-14-21, set 6-in at 1136 ft; Moss B-8, 1-14-21, wosr 1154 ft; Moss B-9, 1-14-21, set 6-in at 1149 ft.

OUACHITA COUNTY — Buffalo Oil Co.'s Culp 1, 22-15-19, sd 2075 ft. Brewer et al's Curry 1, 32-15-19, set 5 3/16-in at 2144 ft. F. A. Book Tr.'s Johnette 3, 33-15-16, sd 2280 ft. Copenhagen et al's Berg 3, 13-15-17, sd 2193 ft. Exchange Oil Co.'s Berg 8, 4-16-15, blg 2600 ft. A. T. Grayson's Reynolds 1, 21-14-17, set 6-in at 1744 ft. Magnolia's Stout B-1, 28-14-16, dr 2772 ft. Marine Oil Co.'s Hayes 5-A, 4-16-15, lcn; Snyder 14, 34-15-15, swbg 2365 ft. J. D. Reynolds' Ghandler 1, 3-14-16, arr to abd 1900 ft. The Texas Co.'s Davidson 1, 26-15-16, dr 2587 ft.

UNION COUNTY—Brown et al's Slaughter 1, 2-17-16, sd 2296 ft. Bondurant et al's Garner 1, 8-18-12, sd 2635 ft. Booth et al's Rowland 1, 8-17-11, dr 2200 ft. Ganther et al's McGough 1, 16-17-13, lcn. Garrett-Modisette Brlg. Co.'s Gregory 1, 10-17-14, lcn. Gulf.'s Murphy 45, 4-16-15, dk; Hardy Murphy 43, 4-16-15, set 4½-in at 2600 ft. Imperial O. & G. Co.'s Murphy 5, 9-16-15, sd 2565 ft; Goodwin 1, 26-17-16, sd 3118 ft. E. M. Jones' Murphy 11, 17-16-15, sd 2522 ft. W. R. Keever's Ezell 2, 12-17-15, wosr 2172 ft; Ezell 3, 12-17-15, set 10-in at 126 ft. Keene & Wolfe's Murphy 4, 9-16-15, set 4-in at 2725 ft; Murphy 6, 9-16-15, dk. Lyall et al's Stegall 1, 11-17-15, sd 47 ft. Lion O. & G. Co.'s Hays 7, 4-16-15, wosr 2286 ft. Magna Prod. Co.'s Tatum 6, 7-16-15, dr 2410 ft. Magnolia's Crawford 3, 8-16-16, dk; Laney 3, 8-16-16, dk; Laney 4, 8-16-16, dk; Wilson 7, 17-16-15, dr 1950 ft. Mountz et al's Pratt 6, 8-18-15, recemented 6-in at 2146 ft. Murdock et al's Vestal 1, 17-16-15, sd 2561 ft. National Cons. Pet. Co.'s W. A. Fagg 1, 8-16-16, wosr 2643 ft. Nat. G. & F. Corp.'s Hill B-3, 5-16-16, lcn. J. J. O'Brien's Saxon 1, 16-16-16, sd 2658 ft. Ohio Oil Co.'s Murphy 5, 9-16-15, 9-16-15, sd 2736 ft; Crain 2, 1-17-14, set 4½-in at 3013 ft; Crain 3, 1-17-14, dk; Will Pumphrey 1, 1-17-14, rig. Pitcher et al's Arkansas Timber Co.'s 1, 21-17-11, rig. Rovenger Oil Corp.'s Harrell 4, 15-17-16, sd 2924 ft. Smitherman & McDonald's Saxon A-2, 32-15-16, swbg 2240 ft. Sun Oil Co.'s Hays 3-16-15, abd 2275 ft. Standard's Murphy 33, 4-18-15, dr 2579 ft. Wingfield et al's Greer 1, 15-19-13, sd 50 ft.

EAST TEXAS

Company, Well and Location	Initial Production Bbls.	Depth
ANDERSON COUNTY—		
Humble, Russell 1, Nancy Cannon sur	*	4043
CHEROKEE COUNTY—		
Humble, Ragsdale 2, N. Johnson sur	*	4566

ANDERSON COUNTY—Brooks et al's Henbry 1, Josepr Mertz sur, dk. Cosden Oil Co.'s Douglas 1, Issack Sur, dr 4540 ft. Humble's Jones 1, Dan Roberts sur, lcn; Spencr Clemens 2, Beason sur, dr 3446 ft.

CASS COUNTY—Mid-Kansas O. & G. Co.'s Rodgers 1, Cass County School Lands sur, dr 2600 ft.

CAMP COUNTY—J. C. Rogers' Byrd 1, R. M. Montgomery sur, rig.

CHEROKEE COUNTY—Humble's Elliott 2, M. Windsor sur, r 3441 ft; Ragsdale 3, N. Johnson sur, dr 618 ft; Reynolds Mortgage Co. 2, J. Durst sur, 4633 ft. Panhandle Oil Co.'s Whalen 1, J. Jordan sur, sd 550 ft. Woodmanse Synd.'s Hall 2, J. Dursts sur, sd 800 ft.

HENDERSON COUNTY—Caton et al's Hoffer & Nash 1, H. Jefferson sur, sd 2910 ft.

HARRISON COUNTY—J. R. Bahan's Hickman 2, lcn not checked, set 6-in at 2754 ft. Greenwood Prod. Co.'s Latex 1, A. W. O. Hicks sur, dr 2600 ft. C. H. Lyons' Bryson 3, T. D. Wilson sur, set 6-in at 1919 ft. Magnolia's Anderson 1, Womack sur, dr 2091 ft; Trosper 2, J. H. Harrison sur, cementing off bottom 2862 ft; Trosper 4, J. H. Harrison sur, dk. State Line O. & G. Co.'s Issacks & Hardman 1, E. Little sur, set 6-in at 1912 ft. Simms Oil Co.'s Abney 2, James Bryant sur, dk.

KAUFMAN COUNTY — Cranfield et al's Nicholson 1, A. Bennett sur, sd 3250 ft.

MARION COUNTY—William Gross Baker's 1, J. French sur, wosr 2391 ft.

NACOGDOCHES COUNTY—Bluie et al's Griffin 1, Jno. W. Anderson sur, dk. Stein & Lewis' Birdwell 1, Jose A. Chirino sur, sd 1100 ft. Union Sulphur Co.'s Whitermark 1, Jose A. Chirino sur, dk.

PANOLA COUNTY—Bethany O. & G. Co.'s Burns 1, W. A. Birdson sur, sd 2580 ft. Magnolia's Jernigan 1, Jane Thorpe sur, dk; Lewis 7, Jas. Johnson sur, wosr 2008 ft; S. Davenport 2, Jessee Dunlop sur, dr 1962 ft; Trosper 1, J. Shandoin sur, set 6⅝-in at 1950 ft.

RUSK COUNTY—C. M. Joiner et al's Bradford 1, K. Ximines sur, dr 784 ft. Magnolia's Durren 1, Agulla Norris sur, dk. McCurrie et al's Sparks 1, Jessee Coarse sur, sd 2143 ft. Rusk Dev. Co.'s Mathews 1, D. Cortinas sur, sd 2330 ft. The Texas Co.'s Schultz 1, A. Loffton sur, dr 2425 ft.

SMITH COUNTY—Dr. Gathier's Parker 1, Don Thomas Quevedo sur, fsh 3251 ft.

SHELBY COUNTY — Magnolia's Pickering Lbr. Co. 1, Wm. J. Crane sur, dr 2805 ft. W. M. Sebastian's Pickering Lbr. Co. 1, T. F. Poily sur, sd 2830 ft.

SABINE COUNTY—Carter Oil Co.'s Mills 2, Anthony Shoals sur, sd 2000 ft. Humble's Temple 16, T. & N. O. sur, dr 804 ft.

UPSHUR COUNTY — S. W. Richardson's Newsome 1, A. Butler sur, sd 2025 ft; Miner 1, A. Lowery sur, cleaning out with cable tools 3500 ft.

WEST TEXAS

Completions

Company, Well and Location	Initial Production Bbls.	Depth
CROCKETT COUNTY—		
Gulf's Powell 2-D	327	2607
Henshaw & Mraland's Noelke-Murphy 1	*	1605
HOWARD COUNTY—		
Magnolia's A. G. Haynes 1	*	3440
JONES COUNTY—		
Gibson-Johnson et al's Joe Dillard 1	*	2306
UPTON COUNTY—		
J. M. Hickey et al's Gormley 1	*	2195
WINKLER COUNTY—		
Humble's Hendricks 1 (Sec. 36)	*	3258

ANDREWS COUNTY—Amon Carter-Zwelfel et al's Cowden 1, elev. 3136 ft, top salt 1575 ft, sd 450 ft for orders. J. S. Cosden et al's Bedford-Ratliff 1, dr 2175 ft. Geo. Calvin & Belt's Bedford-Ratliff 1, dr 1070 ft. Deep Rock Oil Co. et al's W. J. Harris 1, elev. 3173 ft, dr 1195 ft. C. B. McKennon et al's J. S. Means 1, sd 1020 ft.

BORDEN COUNTY—Marland's McDavid 1, lcn.

BREWSTER COUNTY—Van McPhail et al's McIntyre 1, straightening hole 1020 ft. Mid-Kansas' W. W. Turney 1, dr 1050 ft. Wilcox-Anderson et al's Gage 1, sd 1000 ft. Reece & White et al's Kimball 1, spd & sd. Cady & Keler's Decies 1, lcn.

COKE COUNTY—Brown et al's Foster 1, set 8¼ casing at 2210 ft, sd 2250 ft. Danciger O. & R. Co.'s Byrnn 1, run 8¼ cas 2270 ft. Lipan Oil Co.'s Conner 1, run 10-inch cas 1785 ft; Ralins 1, sd 2777 ft.

CONCHO COUNTY — The Exploration Co.'s Hartgrove 1-A, sd 525 ft.

CRANE COUNTY — Crane County Dev. Co.'s Brookfield 1, lcn. C. C. Duffey & Gault Brown's Cowden 1, dr 660 ft. Gulf's Waddell 2, sd 3510 ft, 600 ft sulphur water in hole. Marland's Cardova 1, elev. 2298 ft, top salt 825 ft, putting in lead plug, 2261 ft. The Texas Co. et al's Cardova 1, lcn.

CROCKETT COUNTY—Geo. H. Anderson & Marland's University 1, elev. 2666 ft, top salt 1185 ft, top lime 2142 ft, sd 2632 ft. Blackwell O. & G. Co.'s Powell 2, elev. 2747 ft, top salt 1055 ft, top lime 2505 ft, fsh cas 2627 ft. J. S. Cosden et al's Paul Perener 1, rig. Corbett & Gill's University 1, top salt 855 ft, dr 1720 ft. W. W. Donnelly-Young et al's Massie 1, dr 600 ft; Shannon 1, shut in at 1676 ft, showing between 10 and 12 M ft gas, with some oil. Epenauer et al's Noelke 1, fsh 620 ft. Gulf's Thompson 2, waiting on cement at 845 ft. James Kelly et al's Todd

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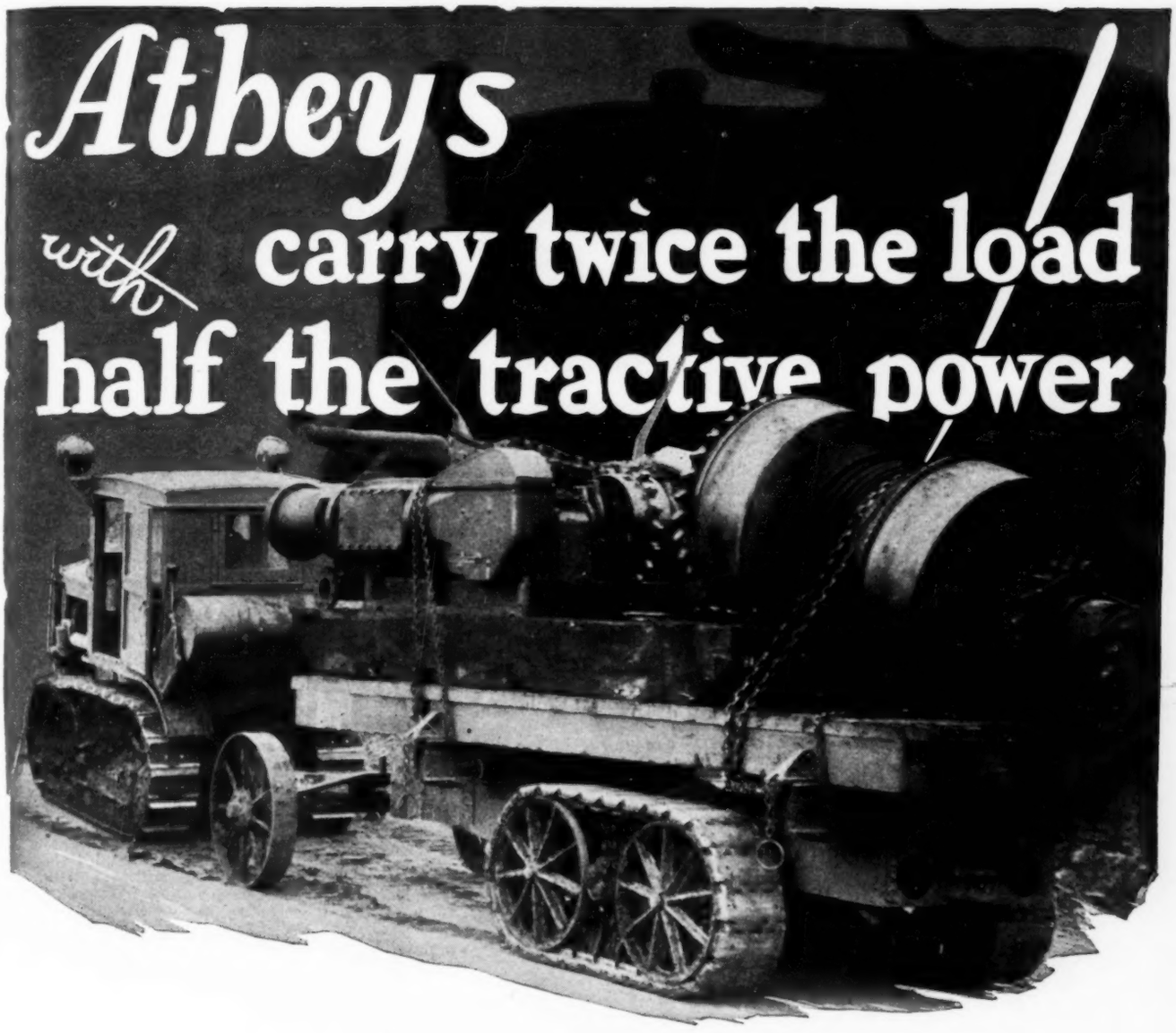

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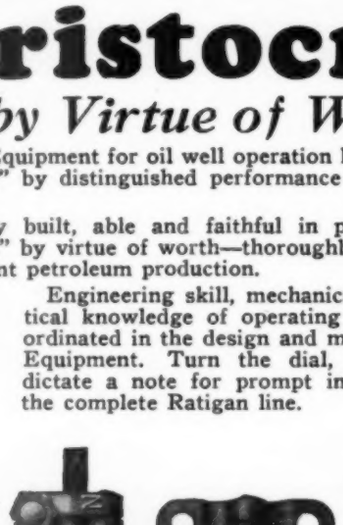

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Sectional View of Timken Roller Bearing

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1, dr 1055 ft. C. A. Jones et al's Powell 1, dr 900 ft. McMannon Oil Co.'s Blakeney 1, sd 2585 ft. Newman Oil Co.'s Clark 1, spd. Osage Oil Co.'s Halff 1, lcn. Wm. Shaffer et al's University 2, elev. 2666 ft, top salt 1060 ft, sd 2635 ft. World Oil Co.'s Shneeman 1-B, dr 1040 ft; Powell 1, lcn. Van McPhail et al's Geo. Thompson 1, lcn. Van McPhail's Geo. Thompson 1, lcn. Cushing Ref. & Gasoline Co.'s Powell 2, fsh 2627 ft.

CULBERSON COUNTY—Jas. H. Gardner et al's Radford 1, sd 585 ft. Deep Rock Oil Co.'s Kloh-Rumsey 2, lcn.

JEFF DAVIS COUNTY—J. K. Hughes Dev. Co.'s Means 2, sd 1250 ft. Humble's C. Flores 1-A, dr 1335 ft.

ECTOR COUNTY—J. S. Cosden & The Texas Co.'s Connell 2-A, sd 3515 ft; Connell 3-A, sd 3545 ft; Connell 4-A, lcn in se corner Sec. 24, Blk. B-16; W. E. Connell 1, moving in material.

FISHER COUNTY—Hucony Oil Co. et al's Langford 1, dr 3700 ft. Marland-Texon's J. S. McCall 1, rig. Marland & Miley Oil Co.'s Ammons 1, dr 3745 ft. Cranfill & Reynold's J. A. Young 1, rig. Sinclair's Farmer Danise 1, preparing to plug, 3119 ft. The Texas Co.'s Stephens 1, skidding rig, junked hole, 2302 ft.

GARZA COUNTY—Gulf's E. P. Swensondale et al A-1, moving in material.

GAINES COUNTY—Westheimer & Daube's Forbes 1, sd 4185 ft.

GLASSCOCK COUNTY — The California Co.'s W. B. Currie 2, machine. Magnolia's Roberts 1, dr 2885 ft. World Oil Co. et al's McDowell 1, elev. 2545 ft, top salt 1180 ft, dr 3895 ft.

TOM GREEN COUNTY—J. V. Cox et al's Llano County Fee 1, sd 306 ft. Fitzgerald & Taliaferro's Bennett 1, sd 1385 ft. Marland's Johnson 1, rig; Johnson 1-"A," lcn. Tulsa Oil Co.'s Adams 1, sd 735 ft.

HOCKLEY COUNTY — World Oil Co.'s Ellwood 1, dr 800 ft.

HOWARD COUNTY—The California Co.'s Fisher 1, sd for 10-inch cas, 2055 ft. W. W. Donnelly & Mann-Freel's Martin 1, elev. 2552 ft, top salt 960 ft, running casing, 3065 ft. F. H. E. Oil Co. et al's Roberts 1-B, making 2M ft of gas, sd 1915 ft; Dora Roberts 2-"A", spudding. Geo. A. Henshaw Jr. & Co.'s Eason 1, sd 1925 ft; W. R. Settles 1, dr 1680 ft, hole full sulhpur water. L. C. Harrison et al's Roberts 3, sd for cable tools, 1580 ft. Magnolia's Kelly-Chalk 2, swab 70 bbls first 24 hrs., prep. to shoot, 1655 ft; Kelly-Chalk 7, testing oil show 1683 ft; Kelly-Chalk 8, dr 1245 ft; Mary Chalk 8, rig; Sarah-Hyman 3, ur 8¼ cas, 900 ft; John Roberts 1, run 6⅝ cas 2922 ft, hole full of water. Marland's Clay 1-E, dr 2622 ft, gray lime, swabbed 160 bbls oil; Jones 1, sd 500 ft; A. M. Fisher 1, elev. 2740 ft, top lime 2950 ft, sd 3505 ft. Marland & Texon's Connelly 1, elev. 2577 ft; Guitar 1-A, elev. 2556 ft, top salt 1215 ft, dr 3218 ft; Settles 2, sd for storage 1928 ft. Sweeney et al's Chalk 1, swabbed 150 bbls after shot, equipping to pump. Vitex Oil Co.'s Clay 1, run 6⅝ cas 1497 ft. Coyle-Concord Oil Co.'s Dora Roberts 1, spudding. Mays, Nixon & Flowers' Flowers 1, dk. Miley-Marland's Read 1, lcn. Peer Oil Corp.'s Read 1, dr 1705 ft.

HUDSPETH COUNTY—Lockhart & Co.'s Moore 1, sd 100 ft; Gardner & Mosley's 1, sd 262 ft.

JEFF DAVIS COUNTY—Humble's Flores 2, dr 1800 ft. J. K. Hughes Means 2, ur 8¼ cas 1600 ft.

JONES COUNTY—E. P. Campbell et al's Herndon 1, sd 3009 ft. R. F. Garland & Co.'s Glynn 1, sd 2435 ft. Hutson & Weaver's 1-A, dr 945 ft. Phillips' Joe Winters 3, rig; Mason 2, dr 1850 ft. Stebbins O. & G. & Sinclair's Scott 1, dr 960 ft; Higgs 2, lcn. W. G. Stough et al's Willis 1, sd 1740 ft; W. C. Bennett 1, dr 525 ft. Swensondale Oil Co.'s Canton 1, ur 6⅝ cas 2545 ft.

KENT COUNTY—Marland-Texon's N. V. Bibly 1, lcn.

KING COUNTY—Humble's Pitchfork 1, dr 1219 ft. Mid-West Expl. Co.'s Patton 1, elev. 1706 ft, dr 3125 ft. Pattison et al's Patton 1, elev. 1616 ft, sd 2670 ft. White Eagle O. &R. Co.'s Burnett 1, elev. 1818 ft, sd 3440 ft.

LOVING COUNTY—Lockhart Bros. Fee 1, lcn.

LYNN COUNTY—Elpo Oil Co.'s Nevels 1, dr 915 ft. Hart Oil Corp.'s Edwards B-7, sd 1400 ft; 1-A, spudded.

MITCHELL COUNTY — Thraves Oil

Corp.'s C. Way 1, elev. 2126 ft, top lime 2140 ft, sd 2509 ft. California Co.'s C. M. Adams 7 N-6, rig. Paul Teas et al's A. C. Mills 1, lcn.

NOLAN COUNTY—Henry Zwelfel et al's Longbotham-Neal 1, elev. 2528 ft, sd 3575 ft. Reiter-Foster Oil Co.'s T. E. Arledge 1, lcn.

PECOS COUNTY—Anderson et al's McKenzie 1, elev. 2928 ft, top salt 1010 ft, sd 2310 ft, for cas., sulphur water in hole; Sherbino 1, rig. Buel-Hagen et al's Batchelor 1, elev. 3166 ft, sd 2820 ft; Jasper 1, elev. 3307 ft, top salt 1527 ft, plugging to abandon 2902 ft. The California Co.'s Smith 2, sd 1488 ft; Smith 3, dr 145 ft; Yates 2, rig; Yates 4, fsh tools 1072 ft, flowed 133 bbls per hr, with 12 M ft gas; Yates 5. cem 8¼ cas 990 ft, waiting on cement; Yates 6, rig; Yates 7, materials; Yates 8, clearing lcn. Day Bros. & McKnight's Yates 1, running 10 cas, 305 ft. M. Z. Dibble et al's Bonebrake 1, sd 640 ft. T. R. Cowell's J. C. Trees 1, elev. 2545 ft, top salt 2305 ft, sd 3460 ft. Douglas Oil Co.'s Sellman 1, sd 738 ft. Bob Elmore et al's Manly Holmes 1, elev. 2176 ft, top salt 335 ft, sd 2011 ft, show of oil and also sulphur water, will probably abandon. R. F. Garland & Co.'s El Paso Fee 1, elev. 3264 ft, top lime 1950 ft, dr 3330 ft, showing sulphur water. Geo. A. Henshaw & Co.'s Corder 1, lcn. Humble's Smith 2, dr 525 ft; Smith 3, dr 335 ft; Mrs. M. A. Smith 1, rig up. Gulf's Mrs. M. A. Smith et al 1, rig; I. G. ates 1, building road; Yates 2, dr 75 ft; Yates 3, dr 90 ft. Kershaw & Livingston's Cannon 1, lcn. Kirby Pet. & Roxana's W. W. Turney 1, set 8¼ casing 1052 ft., waiting on cas. Marland's Yates 2-A, dr 245 ft; 3-A, dr 538 ft; 4-A, spudding. Marland & McMan's Yates 4, sd 1355 ft, flowed 70 bbls, preparing to deepen; Yates 7, dr 95 ft; Yates 8, rig; Yates 9, rig; Yates 10, materials. Madza Oil Corp. & Savoy Oil Co.'s Smith 1, elev. 2705 ft, top salt 800 ft, flowing 17 bbls every two hrs, swabbed dry Oct. 18, at 1578, but was making 200 bbls daily on October 22, at 1578 ft; Smith 2, lcn. Mid-Kansas & Transcontinental's Smith 1, dr 1347 ft; Smith-Tyler 3, rigging up; Smith-Taylor 4, cellar; Yates 8-A, straightening crooked hole, 435 ft; Yates 9-A, rig; Yates 4-B, dr 345 ft; 5-B, dr 180 ft; 6-B, dr 165 ft; 7-B, rig up; 9-B, cellar; 10-B, 11-B, 12-B, lcns; Yates 1-D, dr 635 ft; 2-C, spudding; 3-C, rig; 4-C, 5-C, lcns; 1-E, lcn. Moody Oil Corp.'s Corder 1, lcn. Olean Pet. Co.'s G. A. Harral 1, elev. 3005 ft, top salt 1135 ft, sd 2210 ft; Arthur Harrall 1, lcn; Sherbino Bros. 1, lcn. Red Bank Oil Co.'s Smith 2, dr 150 ft. Roxana's Smith 2-A, rig; Tippett 2, rig. W. R. Shankel et al's Yates 1, sd 1479 ft. Simms Oil Co.'s Smith 2, dr 555 ft. Transcontinental's Blackstone-Slaughter 1, elev. 3539 ft, dr lime 1825 ft. World Oil Co.'s Kloh 1, materials; Serf 1, lcn.

PRESIDIO COUNTY — Hadlock-Miller et Tootle 1, sd 3007 ft. Pinto Canyon Oil Co.'s Fields 1, lcn.

REAGAN COUNTY—Camp & Henshaw Jr. & Co.'s University 1, dr 1330 ft.

REEVES COUNTY—D. R. Thompson et al's Eddins 1, run 8¼ cas, 1740 ft. World Oil Co.'s Duff 1-A, elev 2753 ft, top salt 1940 ft, top Delaware 4185 ft, sd 4189 ft.

RUNNELS COUNTY—Kennedy et al's J. E. Talley 1, dr 780 ft. Noble O. & G. Co.'s Simms 1, sd for 6⅝ cas, 2720 ft. May et al's J. M. Schneider 1, fsh 2401 ft. Miles Oil Co.'s L. S. Lawhon 1, run 8¼ 1885 ft, show gas 960 ft; Chas. Ray 1, cellar. Swensondale Oil Co.'s E. A. Werner 1, run 12¼ cas 290 ft. Owenwood Oil Corp.'s H. B. Fowler 1, lcn.

SCHLEICHER COUNTY — Thos. Gray-Lehman et al's Robinson 1, sd 3004 ft, hfw.

SCURRY COUNTY—J. B. Mims et al's J. J. Koonsman 1, lcn.

STONEWALL COUNTY—Peer Oil Corp. & Producers Oil Co.'s R. P. Morrow 1, run 8⅝ cas 2560 ft.

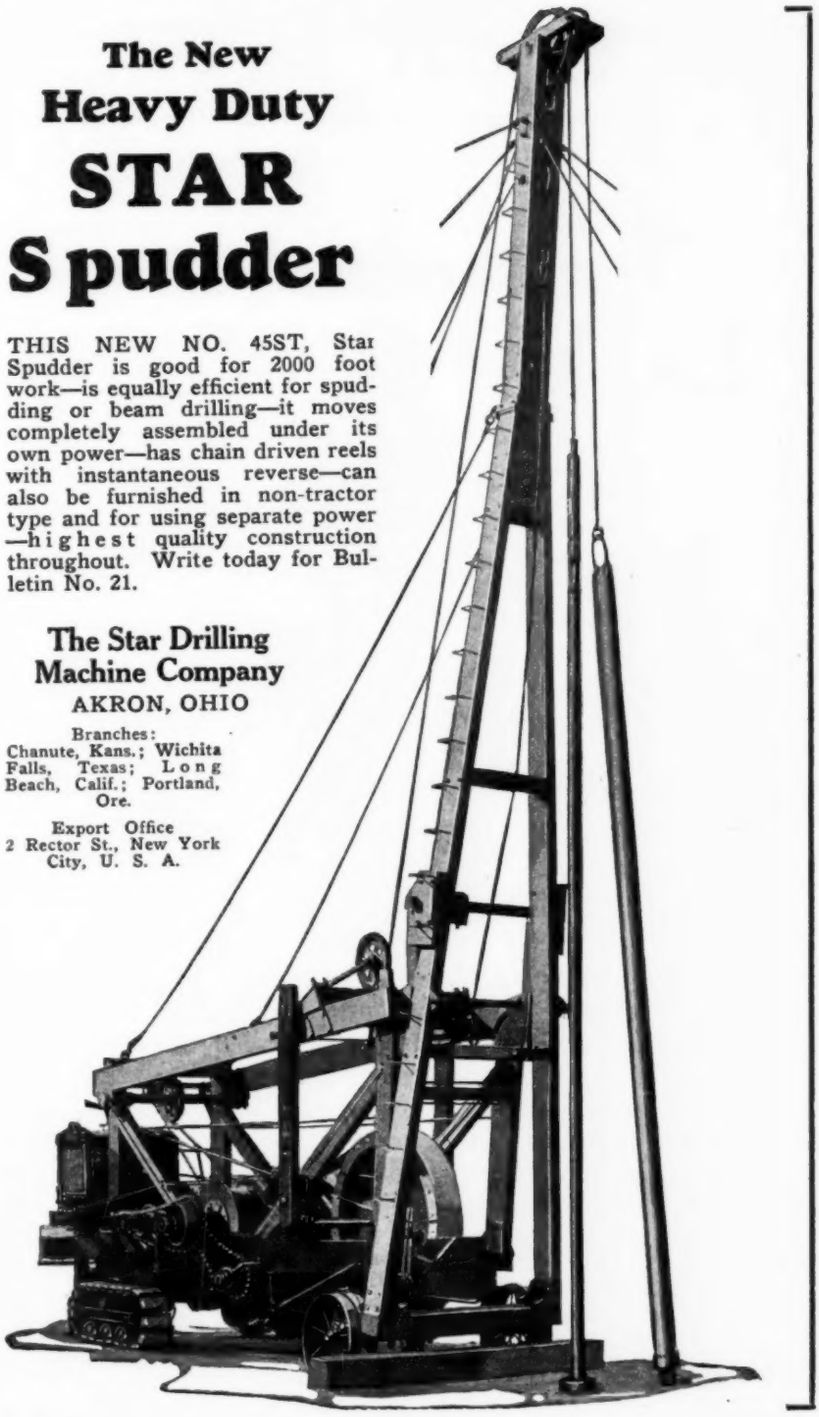
TAYLOR COUNTY — A. J. Brown Prod. Co.'s Henslee 1-A, elev. 2010 ft, rig burned down, total depth of hole 2237 ft. Sloan et al's Latimer 1, sd 2605 ft. Roeser-Pendleton Inc.'s Sam Butman 1, sd 2693 ft, to repair rig. Johnson (Gilbert) & Dyar Brothers' C. M. Brown 1, spudded and sd., installing engine.

TERRELL COUNTY—W. W. Donnelly & Bend Oil Co.'s Bassett 1, lcn.

TERRY COUNTY—Kingsland Oil and Potash Co.'s Brownfield 1, dr 3310 ft.

UPTON COUNTY—Curtis & Hults et al's

The New Heavy Duty STAR Spudder



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Giddings 2, sd 300 ft. Wise & Jackson's Porter 1, sd 3517 ft.

VAL VERDE COUNTY—Douglas Oil Co.'s Sellars 1, sd 3500 ft. Magnolia's Whitehead 1, sd 4340 ft. O. O. Owens et al's Henry Mills 1, sd 2680 ft.

WINKLER COUNTY — Amerada's J. B. ter 1, rigging up to deepen, 2522 ft; Grisham-Walton 1, dr 1485 ft. Atlantic's Grisham-Hun-Hunter 1-E, rig; Grisham-Hunter 2, dr 1240 ft; Grisham-Hunter 1-C, dr 1970 ft; Ida Hendricks 1, dr 2526 ft; Lemar 1, dr 635 ft; Ida Hendricks 1-D, rigged up. Arizona Mining & Eng. Co.'s Hendricks 1, rig. The California Co. & Cranfill Bros. Oil Co.'s M. J. Brashara 1, elev. 2983 ft, top salt 1100 ft, dr 2975 ft. George M. Church et al's Ida Hendricks 1 cem 6⅝ cas in lime at 2430 ft; Ida Hendricks 2, lcn. Cranfill-Reynolds et al's Ida Hendricks 1, top salt 1290 ft, top lime 2478 ft, shows oil 2810 ft, top pay 2875 ft, flows 80 bbls per hr, dr to 2883 ft when flow increased to 420 bbls per hr., later incrased to 500 bbls per hr, not completed; Hendricks 2, top salt 1271 ft, cem 8¼ cas 2468 ft; Grisham-Hunter 1-A, dk. Gulf's Hendricks 2, rig; Hendricks 3, sd storage 2505 ft; Hendricks 4, dr 2790 ft, 20 M ft gas showing; Hendricks 5, sd storage 2505 ft; Hendricks 6, sd storage, 2556 ft; Hendricks 7, sd storage 2520 ft. Tidal Ambrugey 1, dr 4646 ft. Humble's Grisham-Hunter 2, elev. 2824 ft, top salt 1320 ft, top lime 2230 ft, making 15 M ft gas, was killed to lower cas and fish out bit, fsh for bit at 2763 ft; Grisham-Hunter 2, elev. 2824 ft, top salt 1320 ft, top lime 2230 ft, making 75 M gas 2560 ft, sd for orders; Grisham-Hunter 3, top salt 1362 ft, cem 8⅛ cas 2192 ft, putting on bradenhead; Grisham-Hunter 4, cem 8¼ 2206 ft; Grisham-Hunter 5, lcn, moved tools to No. 1-B lcn; Hendricks 1-B, dk; Hendricks 2, digging pit. Independent's Grisham-Hunter 1, dr 2785 ft, 200 ft oil in hole; Grisham-Hunter 2, dr 2625 ft, show gas 2620 ft; Grisham-Hunter 1-B, dk; 31B, lcn; Hendricks 1-B, (Sec. 44) sd for water 1398 ft. Landreth & Roxana's Grisham-Hunter 2, top salt 1830 ft, top lime 2496 ft. dr 2555 ft; Ida Hendricks 1-A, elev. 2791 ft, top salt 1395 ft, top lime 2663 ft, dr 2888 ft, show oil 2688 ft; Ida Hendricks 2-A, spud & sd; 3-A, spd & sd; 4-A, rig; Grishma-Hunter 1-D, rig; Grisham-Hunter 1-C, dr 1765 ft. Liner Dr. Co. et al's Campbell 1, sd 450 ft. Llano Oil Co. & Roxana's Scarborough 1, elev. 2943 ft, top salt 115 ft, swabbed 70 bbls, runnig tubing to put on pump. R. S. Matthews et al's Cowden 1-A, sd 3501 ft. Marland's Hendricks 1, lcn; Hendricks 2, top salt 1297 ft, preparing to cement 8¼ cas at 2420 ft; Hendricks 3, top salt 1225 ft, standardized and sd 2427 ft; Hendricks 4, rigging up. Joe Maxwell & L. C. Turman's Hendricks 1, top salt 1225 ft, prep to cem 8¼ cas at 2391 ft; Hendricks 2, rig. Murchison-Cranfill & Marland's Grisham-Hunter 2, lcn; Grisham-Hunter 3, top salt 1265 ft, dr 2537 ft; Grisham-Hunter 4, lcn. Murchison-Cranfill et al's Grisham-Hunter 1-B, top lime 2309 ft, showed 10 M gas at 2465 ft, tested at 2764 ft, showed 25 bbls oil, killed well to resume dr at 2767 ft. Pure Oil Co.'s Grisham-Hunter 2, sd storage 2689 ft; Grisham-Hunter 3, spd; Grisham-Hunter 1-B, (Sec. 34) elev. 2827 ft, top salt 1395 ft, top lime 2276 ft, how oil and gas, sd 2490 ft; Grisham-Hunter 2-B, elev. 2817 ft, top salt 1295, top lime 2387 ft, standardizing; Grisham-Hunter 3-B, dr 2373 ft; Grisham-Hunter 4-B, lcn. Republic's Grisham-Hunter 1-A, (Sec. 45) cem 8¼ casing 2121 ft, standardizing; Grisham-Hunter 1-B (Sec. 41), elev. 2823 ft, top salt 1300 ft, top lime 2125 ft. 10 M gas at 2125 ft, sd with 2000 ft, dr stem in hole, will probably junk; Grisham-Hunter 2-B, spudding; "A" Grisham-Hunter 11-"B," rig. Roxana's Grisham-Hunter 1-A (Sec. 45) top lime 2428 ft, cem 8¼ cas 2427 ft, sd 2650 ft to change connections; Ida Hendricks 1-B (Sec. 29) elev. 2726 ft, top salt 1330 ft. dr 2865 ft; 2-B (Sec. 29) digging pits; Hendricks 1-C, cem 8¼ 2492 ft, now standardizing; Hendricks 1-D, dr 260 ft. Sheldon & Burden's Ida Hendricks 1, moving in materials. Southern Crude Oil Purchasing Co.'s Grisham-Hunter 1 3-T-68A. standardized and sd 2313 ft; Grisham-Hunter 2, 3-T-68-A, cem 2288 ft, standardizing; Grisham-Hunter 3-T-68-A, cem 12½ 235 ft, waiting on cement; Grisham-Hunter 1, T-89-A, 10 M gas 2473 to 2475 ft, dr 2560 ft; Ida Hendricks 1, 3-T-67-A, dr 2948 ft; Ida Hendricks 2, 3 T-67-A, sd 3050 ft; Ida Hendricks 1-T-67-B,

standardized and sd 2648 ft; Ida Hendricks 4, T-67-C, sd for storage, 2740 ft; Ida Hendricks 1, T-67-F, rigging up to drill deeper at 2529 ft. Texon Oil & Land Co.'s Grisham-Hunter 1-A, dr 2240 ft; 3-A, rotary rig; Grisham-Hunter 1-B, (Sec. 45) dr 1050 ft; Grisham-Hunter 2-B, sd. White Eagle O. & R. Co.'s Leck-Collins 1, dr 3420 ft.

TEXAS

GULF COAST

Completion

FORT BEND COUNTY—
Gulf, Beard 1-A, Long Point .... * 3828

AUSTIN COUNTY — Humble's Payne 1, Raccoon Bend, r. u. T. F. Wood's Trenckman 1, 1½ mi w of Peters, dr 687 ft shale.

BRAZORIA COUNTY — Roxana's Allen Barnard 1, Allen Dome, will dr deeper. Roxana's Allen 4, Alen Dome, dr 5384 ft heavy shale; Randon 1, Allen Dome, dr 1260 ft hard sand; Bell 2, Clemens Dome, coring sandy shale 4016 ft. Dansciger Oil Co.'s Bartlett 1, 3 mi w of W. Columbia, lcn. Gulf's Perry 3, Stratton Ridge, dr 1942 ft, gbo and lime.

CHAMBERS COUNTY — Pure Oil Co.'s Lost River 1, Lost Lake, r. u.

FORT BEND COUNTY—Gulf's Trone 5, Long Point, dr 934 ft, lime and sul; Beard 1-A, Long Point, abn 3828 ft cap rock; Moore 14, Orchard, r. u. Sun's Kasparek 1, Boling putting in rig from Farmer 3, td 1427 ft; Farmer 3, Boling, plugged again, now has steam rig.

HARRIS COUNTY — Dr. P. S. Griffith's Fee 2, 12 mi n of Houston, sd. Juanita Oil Co.'s Kitsman 1, 3 mi n Cypress, resumed drilling 1175 ft, gbo. Humble-Marland's Warren 2, Hockley, dr 370 ft, gbo.

JEFFERSON COUNTY — J. O. Davis & Kinnear's Gladys 1, Spindle Top, fsh 5331 ft. Gulf's Bordages 4, Fannette, dr 2604 ft hard sandy lime. Beaumont Oil & Prosp. Co.'s Tyrell 1, 3 mi nw Beaumont, dr 2694 ft. So. Spindle Top O. & Dev. Co.'s Young 1, 1 mi w of Nede land, dr 1868 ft gbo. Jim McMurry's Crosby 1, 5 mi ne Port Arthur, dr 3640 ft sandy shale; N. S.

LIBERTY COUNTY — Harrison Oil Co.'s Quintette 2, N. Dayton, dr 4368 ft sandy shale. Judge Titwell et al's Gardner 1, 5 mi e of Davis Hill, sd 3508 ft. The Texas Co.'s Havard 1, Davis Hill, wtg for fuel oil, r.u. Barlow et al's Minchcliff 1, 2 mi ne Cleveland, sd 2184 ft.

MATAGORDA COUNTY—Gulf's Sanborn 4, Hawkinsville, set suff. cas. Matagorda County Dev. Co.'s Hawkins 1, Bay City, sd 1985 ft.

MONTGOMERY COUNT — Brain et al's Fitch 1, 3 mi e of Spring, dr 2950 ft shale. Cordell's Lynn's Nichols 1, w of Pinehurst, dr 1620 ft gbo and lime. Johnson Hardy's Hardy 1, 4 mi of Conroe, r. u.

WHARTON COUNTY — Ingrahm Prospecting Co.'s Mensing 1, Boling, sd. C. L. Nail et al's Croom 1, 1 mi east of Wharton, was drilling at 863 ft sandy lime; stuck drill stem pulled in dk; killed driller.

SOUTH LOUISIANA

ASCENSION PARISH — Gulf's United Lands Co. 3, Sorrento Dome, r.u.

CALCASIEU PARISH — Union Sulphur Co.'s Fee 721, Sulphur Dome, will deepen. Dr. Hintze's Beckenstein 1, Sulphur Dome, sd 4260 ft. Newton Dev. Co.'s Dupre 1, Lake Charles, dr 2250 ft gbo. La. Land & Explo. Co.'s Calcasieu Lake 2, bldg dk.

CAMERON PARISH—Pure's Sweet Lake 4, Sweet Lake, pulling liner; Sweet Lake 5, Sweet Lake, sd. Yount-Lee's Black Lake 5, Hackberry, dr 5208 ft shale and lime. Calcasieu Oil Co.'s Caldwell 2, Hackberry, dr 3825 ft, gbo.

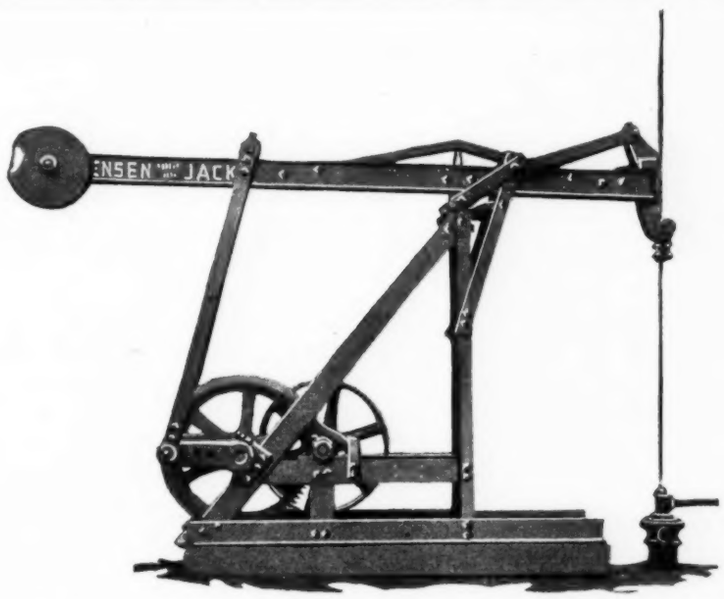
JEFF DAVIS PARISH—Estropal Oil Co.'s Le Doux 2, sd. Jno. Carrodine et al's Walsh 1, Welsh, standing.

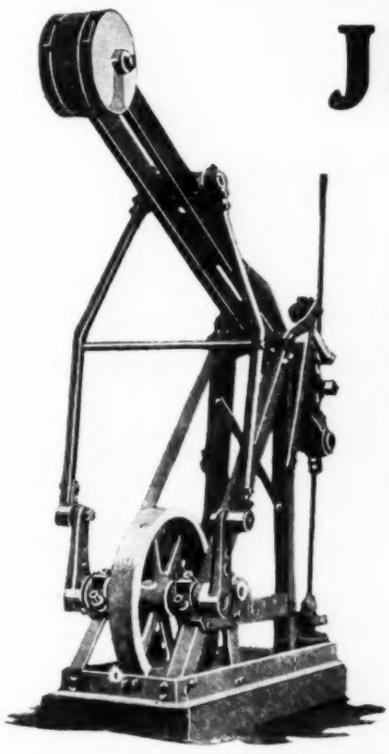
IBERIA PARISH — Calcasieu Oil Co.'s Schwing A-1, Eagle Point, dr 3856 ft hard rk. Gulf's Brussard 1, Fausse Point, sd for repairs. Gulf's State Z-3, Fausse Point, dr 750 ft gbo. La. Land & Explo. Co.'s Vermilion Bay 2, bldg drk foundation.

LA FOURCHE PARISH — Gulf's Dibert-Stark-Brown 1, Thibodeaux, mixing mud.

ST. MARTIN'S PARISH—Rycade's Atchafalaya 1, sd for repairs.

ST. MARY PARISH—Jacob Dannenbaum's





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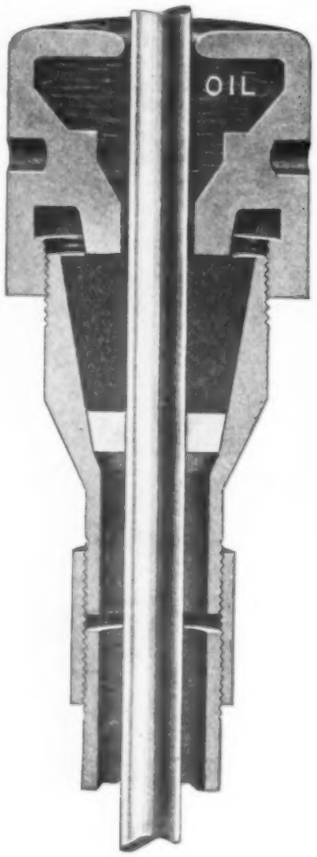

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SOUTHWEST TEXAS

BROOKS COUNTY—The Texas Co.'s Lasater 3, Gyp Hill, dr 4383 ft, hard sand.

CALDWELL COUNTY—Sutton & Smith's Carter 1, 4 miles ne Luling; Carter 2, lcn. Radcliff et al's New 1, 7 miles ne Luling, td 2959 ft sd.

DUVAL COUNTY—Breen Woodward et al's Dinn 1, dr 3698 ft. Schlissinger et al's Moody 2, dr 1800 ft, shale.

HIDALGO COUNTY—Queen City Oil & Gas Co.'s American Land & Drilling & Irri-Co. 1, n Mercedes, fsh 2120 ft. Dale Smith's Daskan 1, temp abn 2107 ft.

JIM HOGG COUNTY—Paesana Synd.'s Campbell 1, 9 miles se Hebbronville, dr below 1855 ft. Hale et al's Jones 1, td 2548 ft. Smi-Lock Oil Co.'s Martinez 1, dr 2460 ft, sandy shale.

MAVERICK COUNTY—Rycade's Sullivan 1, fsh 5132 ft; Chittam 1, sdtrk at 4100 ft; Chittam 2, dr 880 ft, chalk. Ryan Consolidated's India Land Co. 1, 24 miles se Eagle Pass, td 2400 ft. Johnson et al's Wipff 1, tem abn 1365 ft, blue shale.

SAN PATRICIO COUNTY—National Oil Co.'s Jno. McMullen sur 197, acre tr, sd for fuel 1135 ft, gumbo. J. E. Garrett's Fee 1, 1 mile Gregory, dr 2610 ft, hard sand. Houston Oil Co.'s Humble 2, White Point, dr 2318 ft, gas sand; Humble 3, White Point, lcn.

STARR COUNTY—T. G. Folz's Salinas 1, temp abn.

VAL VERDE COUNTY—East Del Rio's Weatherbee 1,, sd 3190 ft. Owens et al's Mills 1, will resume dr 2810 ft. Magnolia's Whitehead 1, sd 4340 ft.

California Permits

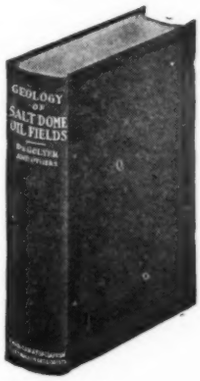
Sacramento, Calif.—The total number of permits issued for new wells to date in California this year is 977, as compared with 1049 issued at the same time last year, according to the latest bulletin issued by the Division of Mines and Mining. Total water shutoffs to date this year number 859, as compared with 1117 at the same date last year. Abandonments in 1927 total 388, as compared with 386 at the corresponding time last year.

Dominguez Test Well

Los Angeles.—The Union Oil Company, principal operator in the Dominguez field, has drilled through some good oil sands below 5500 feet in Callender 17, which is being used to explore the lower levels in the field. Streaks of oil sand have been cut for more than 1000 feet and there is a possibility of commercial production from the series of laminations below 4800 feet. The company probably will not make a test of the well, remaining content to use it primarily as a test well.

Montebello Edge Well

Los Angeles.—The Standard Oil Company has completed its Stocker-Merced 1 in the extreme west end of the Montebello field with a production of 50 barrels of oil and about half as much water. The well was in semi-proven territory and was intended as a test of a large block of acreage held by the Standard. The company has drilled other outpost wells along the edge of the field, with about the same results.



An Official Publication of
The American Association of Petroleum Geologists

Geology of Salt Dome Oil Fields

A Symposium on
The Origin, Structure, and General Geology of Salt Domes, With Special Reference to Oil Production and Treating Chiefly the Salt Domes of North America

By

E. DeGolyer, W. A. J. M. Van Waterschoot Van der Gracht, Marcus I. Goldman, I. P. Voitesti, S. L. Mason, Hans Stille, Donald C. Barton, Sidney Powers, W. C. Spooner, Dave Donoghue, Francis Edward Vaughan, R. H. Goodrich, Lyman C. Reed, P. K. Kelly, H. E. Minor, Roland B. Paxton, A. S. Henley, John R. Suman, George Sawtelle, George M. Bevier, W. F. Bowman, Alexander Deussen, Laura Lee Lane, D. S. Hager, E. Stiles, Paul L. Applin, William Kennedy, Albert G. Wolf, Ben C. Belt, W. P. Henniger.

EDITED BY RAYMOND C. MOORE

With Assistance of Wallace E. Pratt, Donald C. Barton, Alexander Deussen, J. P. D. Hull

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Pleasant Hill Completion Makes 1300 Barrels; Work Increased in Union County, Arkansas

Shreveport, La.—Magnolia Petroleum Company's Hall 2, southwest of section 33-10-12, Sabine Parish, Pleasant Hill field, blew in October 24 while coring at 3245 feet, making at the rate of 1300 barrels of clean oil daily. Tuesday the well gauged 917 barrels in 17 hours of open flowing. Location is about midway between the Arkansas discovery well, near the northeast corner of section 33, and Moffitt's recent large completion in section 5-9-12, being about three-quarters of a mile from each.

The Richland Parish gas area registered the completion of another large gas well during the week when the Natural Gas and Fuel Corporation's Sortor 1, in Section 20-16-6e, came in making fifty seven million cubic feet of gas daily, the second largest well in the field. This company has made locations for two additional tests in section 19-16-6e. The future possibilities of this gas field have not yet been determined since, of the 18 wells drilled, only two have been failures, both of which, however, failed to define the edge of the proven area. An interesting test is now under way that may prove the worth of the field in a north and east direction . This well is being drilled by the Moody and Seagraves interests on their Jones lands, in section 15-18-7e, and is six miles east and seven miles north of the nearest present producer. Six-inch casing has been set and cemented at 2324 feet and drilling in will be started in the very near future.

The Carterville section of Bossier Parish also registered one of the largest gas wells in its history last week, when the Magnolia Petroleum Company brought in the Dodson test in section 16-23-12, flowing at the rate of twenty-eight million cubic feet of gas, from 3080 feet, about the average depth of wells in this territory.

The Lochnager Oil and Gas Company's operations in Catahoula Parish have reached an interesting stage and they are now preparing to make a test of Beazley 2, in section 26-9-6, near Beazley 1, which recently blew out, caught fire, and was abandoned. The second well has been drilled to 3118 feet, 25 feet deeper than the first test, the bottom of the hole being in 10 inches of soft brown sand, immediately below a cap rock. Since the elevation of the respective wells is about the same, many are of the opinion that the gas bearing sand which was present in the first well may have been cased off in the second well. This point will be definitely settled within the next few days, however, as bailing was expected to start during the week.

The Trinity sand area, of Caddo Parish, reported three successful completions during the week, two of which were gas wells and one oil producer. The Arkansas Fuel Oil Company brought in Huckaby 1, in section 14-21-15, as a 150 barrel well, from 3906 feet, after having encountered every known form of bad luck, including the loss of the derrick over the hole. The Dixie Oil Company was credited with two gas completions, one on the Files and Mabry farm, in section 14-21-15, and the second on the Robertshaw land, in the same section. Files and Mabry B-6 was brought in as a 20 million cubic foot gas well, from 3695 feet, while Robertshaw 90 was completed as a 10 million cubic foot gasser from 3683 feet.

Arkansas

Steady performance of the Magnolia Petroleum Company's Carroll well, in the Union County, Arkansas field—now referred to as the Champagnolle field, gives rise to the belief that the next few weeks will witness an appreciable increase in the amount of work in this section. Permits have been issued for a number of tests to be drilled in the vicinity of the Magnolia and Ohio blocks, in addition to which the Rovenger Oil Corporation has begun work of deepening its McCain well, in section 4-17-14, one of the first wells drilled in the territory, originally completed as a small pumper at 2834 feet. The hole has now been cored to 2882 feet, where arrangements are being made to make a test of two feet of sand.

Magnolia Petroleum Company's Carroll well, located in section 1-17-14, continues to flow 337 barrels of clean oil daily, testing less than six tenths of one per cent of sediment, accompanied by approximately two and one-half million cubic feet of gas. No oil has yet been run from the lease and the company now has 11 500-barrel steel tanks filled with oil ready for delivery to the pipe line which is now under construction. The Ohio Oil Company has set a full string of four and one-half inch casing in Crain 2, in section 1-17-14, in an effort to case off a salt water flow which developed after the well was brought in. Plug is

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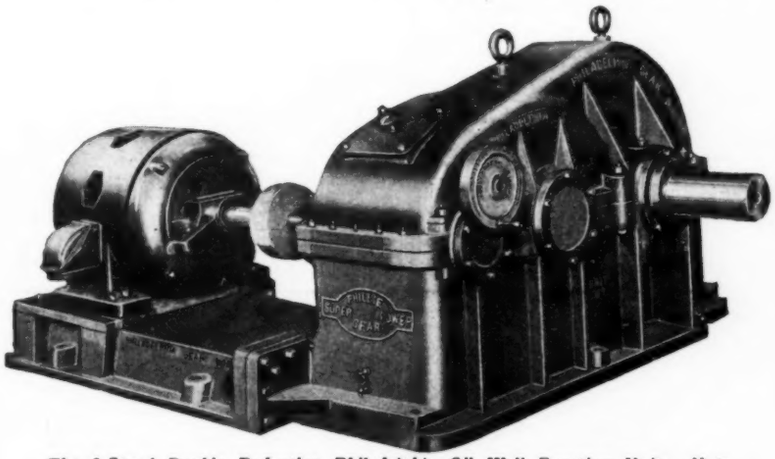

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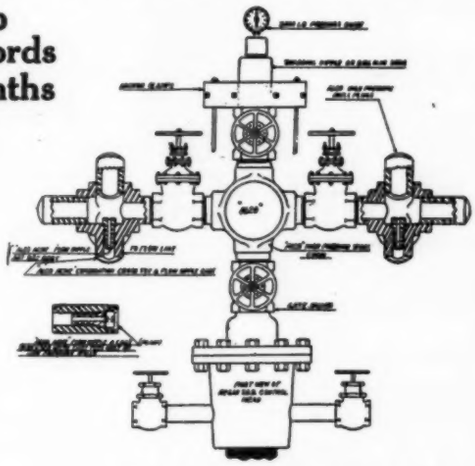

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scheduled to be drilled within the next few days. This same company also has derrick erected over Crain 3, a direct offset to the south of the Magnolia's Carroll well, and is moving in a rig preparatory to starting drilling operations on Will Pumphrey 1, located near the center of the northwest quarter of section 1-17-14. Probably the most interesting test that will be made in this territory within the next few weeks will be that of the Garrett-Modisette Drilling Company on the Gregory land, in section 10-17-14, almost midway and a little south of the Magnolia and Ohio companies operations and the Rovenger Oil Corporation's McCain well, which is located approximately two and one-half miles west. This test should reveal the future possibilities of the area lying between the two wells now producing.

Mexican Production Loss More Than 50 Per Cent

Washington, D. C.—Mexican petroleum production is continuing the downward trend first manifested last year, dropping by July of this year to slightly under 5,500,000 barrels, according to a study of the situation just completed by the minerals division of the Department of Commerce.

Petroleum activities in Mexico are said to have declined at least 50 per cent since January 1, 1927, and with a continuance of present conditions there will be much further curtailment. One of the leading refineries has been reported recently closed because of an inadequate supply of crude.

Salt water, rather than disturbed conditions as a result of the Mexican oil controversy or recent revolutionary outbreaks, is given as the reason for the rapid and steady decline of Mexico as a leading oil producing country. The incursions of salt water in the various producing areas cut the output last year to 90,420,973 barrels, as compared with 115,514,700 barrels the year before, and will be responsible for even a greater decline this year.

Discussing this decrease in a recent bulletin, it is explained by the Tampico Chamber of Commerce that it "was in spite of all efforts of the companies to bring in new production, as more wells were drilled in 1926 than had been drilled in the year previous. Without exception, there is salt water in every producing area, and the only new pool to be brought in during the year was in Altamira, Tamaulipas."

Emmett H. McMann, field superintendent of the Shell Company in the Brea district, was fatally injured in an automobile accident near Las Vegas, Nevada, October 14, dying later in a Las Vegas hospital. The accident occurred while Mr. McMann was on a hunting trip. He was one of the best known superintendents in the State. He leaves a wife and three children.

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PERMITS

(Continued from page 78)

COOKE COUNTY — Texas Co., Wichita Falls, Hocker 3, B 13, T. Scott sur, 435 ft from n and 150 ft from e line.

CALDWELL COUNTY—Humble, Houston, Ginges 1, Damenn sur, 780 ft se and 150 ft from ne line. Texas Co., Houston, Clingsmith 7, Damen sur, 150 ft from s and e lines.

CHAMBERS COUNTY—Pure Oil Co., Ft. Worth, Lost River 1, State Permit.

COMANCHE COUNTY — Amerada Pet. Corp., Cisco, Bryson 2, A. Kleb sur, 150 ft from n and e lines; Bryson 1, J. E. Taylor sur, 150 ft from n and e lines.

CLAY COUNTY—Carter, Fine & Carter, Wichita Falls, Henderson 1, 2615 TE&L sur, 150 ft from n and w lines.

CRANE COUNTY—Magnolia Pet. Co., Dallas, Hardwicks 16, S 46, B 30, University Lands sur, 330 ft from s and w lines; Bowers 1, S 63, B 2, H&GN sur, 330 ft from s and w lines.

EASTLAND COUNTY — P. L. Homan, Cisco, Stewart 1, S 33, B 3, H&TC sur, 300 ft from s and e lines. J. E. Lewis & Co., Eastland, Hargus 4, S 3, B 13, ET Ry sur, 1512 ft from n and 850 ft from e line. Mook-Texas Oil Co., Fort Worth, Sibley 9, W. Van Norman sur, 150 ft from e and 1000 ft from s line. Gulf Production Co., Fort Worth, Parsons 9, S 53, McL CSL sur, 300 ft w of No. 8. Milham Corp., San Antonio, Barnett 4, S 15, B 3, H&TC sur, 300 ft from s and e lines.

FALLS COUNTY—Pottinger & Stubbs, Austin, Allen 1, P. Zarza sur, 150 ft from e and 550 ft from s line.

FISHER COUNTY—Cranfill & Reynolds, Cisco, Young 1, S 208, B 1, BBB&C sur, 980 ft from n and e lines.

FORT BEND COUNTY—Gulf Production Co., Houston, Moore 14, L. Burknap sur, 300 ft e of No. 10.

GRAY COUNTY—Magnolia Pet. Co., Dallas, Bowers 1, S 63, B 2, H&GN sur, 330 ft from s and w lines. Humble, Wichita Falls, Binkley 1, S 86, B 3, I&GN sur, 330 ft from n and e lines. Danciger Oil & Ref. Co., Wichita Falls, Jackson 2, B B2, S 88, H&GN sur, 330 ft from s and w lines; 3, 660 ft w of No. 2. Skelly Oil Co., Tulsa, Jackson 1, S 88, B B2, H&GN sur, 330 ft from n and w lines. Texas Co., Wichita Falls, Chapman 1, S 51, B 25, H&GN sur, 990 ft from w and 330 ft from n line. Majestic Oil Co., Amarillo, Bowers 2, S 93, B B2, H&GN sur, 310 ft from n and e lines.

GLASSCOCK COUNTY — California Co., Colorado, Currie 2, S 213, B 29, W&NW sur, 330 ft from n and e lines.

HARRIS COUNTY—Rio Bravo Oil Co., Houston, Settegast 7, S 44, J. Robinson sur, 2240 ft from n and 125 ft from e line; GH&SA 1, No. 51 J. Hamilton sur, center; GH&SA 101, BBB&C sur, center. Ray Oil Corp., Houston, Holmes 4, J. B. Jones sur, 100 ft from w and 80 ft from s line. Gulf Production Co., Houston, Taylor 22, No. 52 J. Hamilton sur, 200 ft s of No. 19; Wright 21, Wm. Scott sur, sw of No. 3.

HARDIN COUNTY—Paraffine Oil Co., Houston, Knight 43, J. Knight sur, 92 ft from n and 40 ft from w line.

HALE COUNTY—Talbot & Simms, Plainview, Dyer 1, S 18, B A3, R. M. Thompson sur, 200 ft frmo n and e lines.

HUTCHINSON COUNTY—Prairie Oil & Gas Co., Ranger, Merchant 2, S 37, B 47, H&TC sur, 100 ft n of No. 1. Roxana Pet. Corp., South Bend, Cockrell 3, S 3, B B3, D&SE sur, 220 ft from n and 330 ft from w line.

JEFFERSON COUNTY—Freeport Sulphur Co., Freeport, Texas Explo. Co. 2, S. Eaton sur, south central. Rio Bravo Oil Co., Houston, T&NO 2, J. Douthitt sur, 50 ft n of center of s line.

JACK COUNTY—Chapman & Fitzhugh & Tedfo d, Wichita Falls, Contrell 1, S 2, SP Ry sur, 450 ft from e and 150 ft from s line. Buttram Pet. Corp., Oklahoma City, Jones 5, No. 5 SP Ry sur, 300 ft from w and 90 ft0 from s line; 6, 300 ft from s and w lines.

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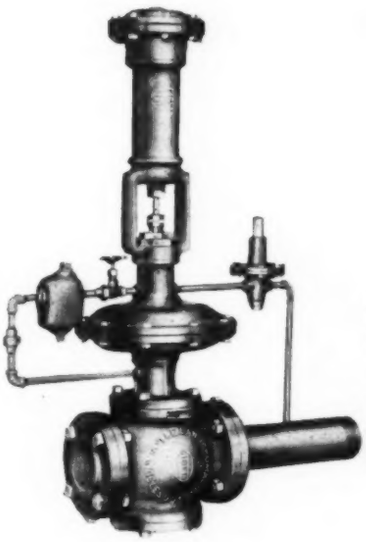

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To maintain a steady boiler pressure with low pressure burners requires absolute control of the gas pressure in response to the requirements of the boiler, due to changes in the load.

This is positively accomplished by the Neilan Combination Boiler Governor and Gas Regulator. It controls the gas pressure at the burners so as to give perfect combustion and maintain a constant boiler pressure with practically no variation.

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Suitable for:

Boiler Pressures: 5 to 60 lbs; 60 to 175 lbs; 175 to 350 lbs.
Burner Pressures: 1 oz. to 10 lbs; 10 to 30 lbs; and 30 to 85 lbs.

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Bartlesville, Okla., Mason 2, S 18, B 19, T&P sur, 300 ft from s and w lines.

JIM HOGG COUNTY—Magnolia Pet. Co., Dallas, Merchants Bank 30, S 415, F. M. Brister sur, 400 ft se of No. 25.

LAMAR COUNTY—Hart & Cole, Inc., Dallas, Booth 1, W. Askins sur, 1500 ft from e and 600 ft from s line; Fair Grounds 1, W. Askins sur, 150 ft from n and e lines; Hodges 1, R. Russell sur, 150 ft from w and 1350 ft from s line.

LIVE OAK COUNTY—Roy Shipman, Callihan, Kolb 1, B 44, C. F. Simmons sur, 150 ft from s and w lines. Encino Gas Co., San Antonio, Stewart 1, E. McWhorter sur, 500 ft from n and e lines.

LIMESTONE COUNTY— Transcontinental Oil Company, Mexia, Lewis 2, P. Varela sur, 300 ft n of No. 1; Ward 2, P. Varela sur, 900 ft sw of No. 1.

LOVING COUNTY—Lockhart & Co., Colorado, Fee 1, S 85, B 35, H&TC sur, east cen.

MONTAGUE COUNTY—Bridwell & Heydrick Oil Co., Wichita Falls, Salmon 2, F. Robertson sur, nw cor. Texas Co., Wichita Falls, Farmer 1, S 1, J. Poitevent sur, 150 ft from n and w lines.

MONTGOMERY COUNTY—Hardy, Houston, Hardy 1, C. B. Stewart sur, sw corner.

MEDINA COUNTY—F. Banderet et al, Bay St. Louis, Miss., Mofield 1,S 532, Brotag sur, sw corner. Golden West Oil Co., San Antonio, Schmidt 4, B 7, P. E. Durst sur, No. 15, 206 ft ne of No. 2.

MILAM COUNTY—W. A. Jones, Minerva, Smith 3, T. J. Chambers sur, 60 ft w No. 1.

MATAGORDA COUNTY—Valley Oil Co., Houston, Hudson 1, B 4, H. Parker sur, 50 ft from n and 200 ft from e line.

PECOS COUNTY—McMan Oil & Gas Co., Tulsa, Yates 9, S 34½ B 194, GC&SF sur, 275 ft from n and 330 ft from e line; 10, 275 ft s of center of n line . J. W. Reynolds & Co., San Antonio, Bruner 1, S 64, B A2, 300 ft w of center of e line. Allsman & Bell, McCamey, Pecos River 4, S 61, B 1, I&GN sur, 325 ft nw of No. 3.

REAGAN COUNTY—Skelly Oil Co., Tulsa, Grayson 1, S 33, B 8, Univ. Lands sur, 330 ft from s and w lines. Big Lake Oil Co., Best, University 3, S 1, B 2, Univ. Lands sur, 595 ft w of No. 90.

SHACKELFORD COUNTY—J. O. Hyde, Albany, Moberly 1, S 13, B 11, T&P sur, 150 ft from s and e lines. Hope Oil & Gas Co., Fort Worth, Reynolds 1, S 24, B 11, T&P sur, 150 ft from n and e lines. H. E. Trowbridge, Cisco, Townsend 5A, B 55, Univ. Lands sur, 1550 ft from n and 170 ft from w line; 6A, 300 ft n of No. 5. T. G. Shaw, Fort Worth, Edgar 9, S 20 Bayland Asy sur; 10; 11; 12; Rice 7, S 44 Bayland Asy sur, 450 ft from s and w lines. G. C. Byrd, Albany, Rice 1, S 44 Bayland Asy sur, 150 ft from n and e lines. T. G. Shaw, Fort Worth, Edgar 7, S 20 Bayland Asy sur, 300 ft w of No. 5; 8, 300 ft ne No. 4.

STEPHENS COUNTY—A. J. Broderick, Ft. Worth, Keel 1, S 6, B 5, T&P sur, south central.. Corzelius Bros. & Taggart, Eastland, Chesley 1, S 384, BCSL Ry sur, sw cor.

TAYLOR COUNTY—C. C. Cady, Moran, Burns 1, S 68, LAL sur, 750 ft from n and 450 ft from w line.

UPTON COUNTY—Southern Crude Oil Purchasing Co., Shreveport, La., H&TC 1, S 61, B 35, H&TC sur, 330 ft from s and w lines.

WICHITA COUNTY—Petroleum Prod. Co., Wichita Falls, Kemp & Kempner 1, B 49, WVFL sur, 150 ft from n and 506 ft from e line. J. L. Swanner, Wichita Falls, Williams-Parker 1, B 4, J. McCool sur, 262 ft from n and 325 ft from w line. Howell & Somers, Wichita Falls, Mirschi 1, B 834, D. Cowan sur, 150 ft from s and w lines. Simms Oil Co., Dallas, Preston 7, B. H. Preston sur, 1050 ft from n and 15 0ft from e line. Texas Co., Wichita Falls, Waggoner 336, N. B. Meade sur, 1270 ft from s line. T. J. Pyle, Wichita Falls, Kemp & Kempner 3, B 18, WVFL sur, 68 ft sw of No. 1. Vergate Oil Co., Tulsa, Eagle 10, S 4, B 55, WVFL sur, 50 ft sw No. 6. W. D. Cline, Wichita Falls, Goetze 1, No. 2 GC&SF sur, 150 ft from w and 750 ft from s line. Hammon & Garrett, Wichita Falls, Kemp & Kempner 1, S 2, SP Ry sur, 150 ft from s and w lines. Electra-Gulf Oil Co., Electra, Watkins 8, B 46, WVFL sur, 450 ft from n and 700 ft from e line.

WILBARGER COUNTY—Phillips Pet. Co., Bartlesville, Okla., Waggoner 8, S 44, B 4, H&TC sur, 440 ft e of No. 1; 9, 220 ft from s and e lines. Texas Co., Wichita Falls, Castlebury 2, S 66, B 14, H&TC sur, 750 ft from n and 450 ft from e line. Consolidated Oil Co., Wichita Falls, Waggoner 1-C, S 4, H&GN sur, 150 ft from s and e lines.

WINKLER COUNTY—Independent Oil & Gas Co., McCamey, Varclaman 1, S 41, B B5, 330 ft from s and e lines. Texon Oil & Land Co., Big Lake, Hendricks 3A, S 41, B B5, School sur, 330 ft from n and w lines. Dixie & Southern Crude Oil Purchasing Co., Shreveport, La., Hendricks 3, S 28, B B5, School sur, 330 ft from n and w lines; 4, 330 ft from s and w lines; Hendricks 3, S 35, B B5, School sur, 330 ft from n and w lines.

WEBB COUNTY—O. W. Killam, Laredo, Bruni 7, B 65, Arriba sur, 1000 ft w of No. 5. Houston Oil Co., Houston, Bruni A2, S 10, M. Arisbe sur, 200 ft from nw and 150 ft from ne line.

YOUNG COUNTY — Robert Oil Corp., Breckenridge, Keen 1, 3401 TE&L sur, 690 ft from w and 170 ft from s line. Pitzer & West, Breckenridge, Morrison 2, B B, E Sherrell sur, se cor.

ZAPATA COUNTY—O. W. Killam, Laredo, Hinnant 2, S 74, 2200 ft w of No. 1.

Plan Gas Line Extension

Great Falls, Mont.—Financial institutions which are interested in the Hope Engineering & Supply Company's line for natural gas now being laid between Kevin-Sunburst and Great Falls anticipate an early extension of the line to cities to the south of Great Falls. To make a preliminary survey in anticipation of probable future extensions, a party of 12 bankers from the West Coast will arrive in Shelby soon to make an extended trip through the northern Montana gas territory. The party is to be headed by F. A. Freeman, representing Freeman, Smith & Camp Company of Portland.

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